COUNSELING-RELATED CORRELATES OF BRAIN LATERALITY PREFERENCE

By

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To

Those kindred spirits who seek their way with a hammer

and rejoice in the hollow sound of their yesterday's truth.

"Even the most courageous among us only rarely has the courage

for that which he really knows."

Friedrich Nietzche
Twilight of the Idols

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Abstract of Dissertation Presented to the Graduate School
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COUNSELING-RELATED CORRELATES OF BRAIN LATERALITY PREFERENCE

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This study investigated the relationship between brain laterality preference and a broad range of counseling-related personality factors categorized in terms of creative functioning, occupational interest, affective functioning, and other general factors. The sample consisted of 205 right-handed, degree-seeking community college students, comprised of 58 males (28%) and 147 females (72%).

Brain laterality preference was measured by Your Style of Learning and Thinking (SOLAT), Form C, and the Brain Preference Indicator (BPI). The personality factors were derived from the Sixteen Personality Factor Questionnaire (16PF), Form D. Correlational techniques were used to test the relationship between brain laterality preference and each counseling-related personality factor. A significant sex difference was found in seven of the 33 factors (none of them related to the laterality measures). Regression analysis revealed a positive correlation between left hemispheric preference and age. A number of significant relationships were found between brain laterality preference and the 16PF factors within each major category, the only exception being affective functioning for males.

In contrast to findings expressed in past research, creative factors were positively correlated with left hemispheric preferences for both sexes. For females, however, the data confirmed earlier studies also linking creativity to integrated hemispheric functioning. The factors concerned with occupational interests were generally positively correlated with a left hemispheric preference and negatively correlated with a right hemispheric preference. Brain laterality preference was significantly related to affective functioning for females but not for males. For females, the findings confirmed an association between right hemispheric preference and emotional variables. Also, a positive relationship between integrated preferences and emotional stability was evident. A number of significant relationships were also found between brain laterality preference and other general personality factors, particularly for the Self-Discipline and Warmth factors.

The study included specific implications related to counseling practices, requiring further validation before application. Suggestions for further research were related to the study of creativity, affective functioning, sex differences, cultural differences, other instrumentation, other samples, the counseling process, and the use of truly experimental designs.

CHAPTER I

INTRODUCTION

Through a process of research, trial, and inquiry, counseling has made significant progress towards an understanding of human behavior. Research into the nature and function of the human brain is one of the most recent avenues of such inquiry--one that promises to change the way in which counselors view their clients, their techniques, and their profession. The part of this research related to brain laterality has brought to light many interesting and significant implications for the human services professional.

Background

The concept of a distinction between the functions of the right hemisphere (RH) and left hemisphere (LH) of the cerebral cortex (i.e., brain laterality) has recently emerged into the popular consciousness. Wonder and Donovan (1984) described the benefits of "Whole-Brain Thinking" in terms of achieving enhanced job performance. In the best seller In Search Of Excellence, Peters and Waterman (1982) described the "intuitive" (RH) approach of successful business leaders and espoused the obsolescence of the purely "Rational Model" (LH) approach to management.

Robert Ornstein (1972, 1976) proposed a "psychology of consciousness" based upon the implications of research on brain laterality and Arthur Janov (1975, 1980) applied these principles to an understanding of neurosis and psychotherapy. The Public Broadcasting System has aired an eight part documentary on the brain (one segment of which was devoted to "The Two Brains"), thus creating more widespread awareness of the significance of brain laterality.

As is often the case, such popular concepts are practical extensions of basic research conducted by serious investigators who are somewhat more reluctant to generalize the results to such diverse concerns. Indeed, although only recently popular, the scientific study of the structure of the human brain and its relationship to behavior is well over a century old.

In the 19th century, the work of Dax and Broca (cited in Springer & Duetsch, 1981) first made an association between damage to the left side of the brain and the ability to speak. Although unappreciated at the time, these observations were confirmed by numerous later studies and anticipated an exciting era of research into the effects and implications of brain laterality.

Left and Right Modes

Bogen (1969b, pp. 150, 158) presented a compilation of dichotomous terms commonly used to describe modes of thinking. Excerpts are presented in Table 1 in order to give the reader a perspective on the differences involved in laterality and the scope of their identification.

The comparisons in Table 1 are presented in order to provide a conceptual framework for further discussion and not as a final or formal classification. There is not universal agreement concerning a dichotomous model of hemispheric function. Several researchers have suggested a continuum of function (Bradshaw & Nettleton, 1981; Hermann, 1981). Allen (1983) outlined a number of distinct models of laterality processing supported by current research (to be covered in a separate section in the review of the literature).

Table 1

Associations with Left and Right Mode Hemispheric Processing

Author	Left mode (LH)	Right mode (RH)
Bogen	propositional	appositional
Bogen and Gazzaniga	verbal	visuospatial
Bruner	rational	metaphoric
Freud	secondary process	primary process
Goldstein	abstract	concrete
Jackson	expression	perception
Levy-Agresti & Sperry	logical	synthetic
	analytic	perceptual
Milner	verbal	non-verbal
Price	analytic	synthetic

Note. Adapted from "The other side of the brain II: An appositional mind" by J. Bogen, 1969, Bulletin of the Los Angeles Neurological Societies, 34, 135-162.

Counseling-Related Factors

The study of the human brain promises to dramatically expand our knowledge of the mechanisms of human behavior. Systematic, scientific research in this area, however, is still in its infancy and much remains to be done to clarify and apply the newly emerging evidence of brain laterality. Sufficient evidence exists to document some general functional differences in the way the two cerebral hemispheres process information. These differences involve key elements contributing to the understanding of human behavior.

There is evidence to support the proposition that individuals may tend to prefer the functions of one hemisphere over the other and can therefore be classified according to their brain laterality preference (Torrance & Reynolds, 1980; Wonder & Donovan, 1984). Such a classification system may have implications for many areas of concern within the counseling profession.

The following general categories have been selected based upon a thorough review of the literature as those classifications most closely related to significant counseling concerns. A brief introduction to each category is presented below. A thorough review of each will be presented in Chapter II.

Creative functioning

Creative functioning is an area of interest to many in the counseling and student development profession. Torrance and Reynolds (1980) cited research utilizing over 17 measures of creativity and found a significant correlation between RH laterality preference and

creativity. Related to this finding, Edwards (1979) developed a "cognitive-shift" model of teaching art which actively attempts to facilitate movement towards RH laterality. Also concerned with this area, Carl Sagan (1977) concluded that most significant creative accomplishments are the result of an integrated use of both LH and RH functions.

Occupational implications

Occupational differences in laterality have significant implications for career counseling. Springer & Deutsch (1981) speculated upon possible associations between brain laterality preference and occupational choice and cited research (Bakan, 1969) which correlated lateral eye movement (as an indicator of laterality) with college major. Goodspeed (1983) presented the Hermann Occupational Profile which classifies over 25 careers as either LH oriented (e.g., planners, critics, doctors, researchers) or RH oriented (e.g., artists, musicians, dancers, top executives).

Affective factors

Emotional factors are of key concern to counseling and student personnel professionals. Ley and Bryden (1982) suggested that all emotional responses are primarily mediated by the RH; while Tucker (1981) proposed that positive emotions are primarily LH mediated and negative emotions are RH mediated.

This trend of exploring the psychological role of laterality has been extended by none other than Carl Rogers. Rogers (1980) admitted to

being influenced by Lancelot White, the historian of ideas, who believed that the unconscious (i.e., the nonverbal RH) takes precedence over the conscious (i.e., verbal LH) in the unification of feeling, thought, and behavior.

Other personality factors

Students of human behavior are also interested in a variety of other personality factors such as leadership, dominance, independence, and conformity. A common finding concerned the intuitive (RH) preference among the top level (presumably dominant and high leadership type) managers (Coulson & Strickland, 1983; Agor, 1983). A number of other such variables (e.g., field-dependence, social perception) will be covered in the review of the literature.

Statement of the Problem

Most basically, the problem was a lack of data on brain laterality integrated within a comprehensive set of personality variables in such a way as to be meaningful and useful to counseling professionals. The great majority of available research has studied brain laterality in relationship to very specific physiological functions and abilities. This study involved an approach which started with a comprehensive, standardized measure of personality and utilized two brain laterality preference measures in an attempt to formulate a broad perspective on the relationship between laterality and counseling concerns. Such a perspective was lacking in the literature on brain laterality.

This study was also designed in a way to make rather abstract basic research more meaningful to the counseling professional. By integrating research (conducted largely by physiologists and neuropsychologists) into a framework of familiar psychological variables and counseling concerns, the results become more relevant to practitioners. Hopefully this will stimulate further research aimed at the practical application of brain laterality findings to the field of counseling--an area which has not thus far been directly and intentionally addressed.

Purpose of the Study

The purpose of this study was derived from the concerns identified within the problem statement. Specifically, the purpose was to:

1. explore brain laterality preference in relationship to a comprehensive array of counseling-related personality factors and, as a result of this, to
2. identify associations which merit further research.

Research Questions

The study was focused upon four research questions which reflect the purpose of this research:

1. Is brain laterality preference correlated with personality factors related to creative functioning?

2. Is brain laterality preference correlated with occupational interest factors?
3. Is brain laterality preference correlated with personality factors related to affective functioning?
4. Is brain laterality preference correlated with other general personality factors?

In Chapter III, these questions are formulated into null hypotheses. Within these hypotheses, the specific factors which were examined are identified.

Definition of Terms

The field under investigation has its own terminology for describing its subject. Since such terminology is probably not familiar to counseling professionals, a few key terms will be defined before proceding to the review of the literature.

Brain laterality is a term describing the functional differences between the two hemispheres of the cerebral cortex of the brain. Brain laterality preference is defined as the self-reported preference for the functions of one hemisphere relative to the other as measured by the two instruments utilized within the study; usually expressed as left-hemisphere or right-hemisphere preference or as a relative point along a continuum between the two preferences. The left hemisphere (LH) of the cerebral cortex is also sometimes referred to as the "left brain", the "dominant", or "major" hemisphere because of the early discovery of its

predominant role in verbal and reasoning functions. The right hemisphere (RH) is also at times referred to as the "right brain".

Commissurotomy is a surgical procedure involving the severing of the corpus callosum, used as an experimental treatment for intractable epilepsy. The corpus callosum is a bundle of over 200 million nerve fibers which connect the two cerebral hemispheres. A split-brain patient is a person upon whom a commissurotomy has been performed.

Persons who are right handed (dextrals) seem to differ from those who are left handed (sinistrals) in the lateralization of certain functions. Sensory functions may have either an ipsilateral (associated with the same side) or a contralateral (associated with the opposite side) relationship to the allocation of functions in the cerebral cortex.

Organization of the Remainder of the Study

Chapter II reviews the literature relevant to brain laterality and its implications within the scope of this study. Chapter III presents the research methodology. Sampling, procedures, instrumentation, statistical analysis and assumptions, and limitations are discussed. Chapter IV presents the research findings. A section on the distribution data precedes presentation of the correlational data. Chapter V summarizes and discusses the results, the implications of these results, and suggests further research relevant to counseling and student personnel.

CHAPTER II

REVIEW OF THE LITERATURE

Bradshaw, Nettleton, and Taylor (1980) proposed a classification system for research related to cerebral laterality. This system is comprised of close to 100 distinct categories of research. Although this provides a sense of the scope of the literature, fewer and broader categories of research related to counseling concerns will be utilized for the purpose of this study.

The review will cover (a) anatomical asymmetries of the brain, (b) methods used in experimental research on the brain, (c) a selective review of evidence for functional asymmetry, (d) a review of theoretical models of cerebral laterality, (e) a brief summary of the variables which affect laterality, and (f) the literature which examines implications of laterality for counseling-related areas (i.e.,creativity, occupational implications, affective implications, and other personality factors).

Anatomical Asymmetries

Even though the two cerebral hemispheres appear to be mirror images of one another, closer inspection has revealed a number of anatomical differences between them. This asymmetrical nature of the brain was noted by Gratiolet in the 1860's, in 1878 by Heschl and again in 1890 by Eberstaller (cited by Kolb & Whishaw, 1980). Such findings were largely

disregarded until Geschwind and Levitsky (1968) submitted their work based upon the study of a large number of human brains. The reader is referred to Kolb and Whishaw (1980) for a summary of the more significant anatomical asymmetries found between the left hemisphere (LH) and the right hemisphere (RH).

These asymmetries have been confirmed in the living brain through the use of modern research methods. LeMay and Culebras (1972) used a procedure known as cerebral angiography, involving the study of blood flow through the brain. LeMay and Kido (1978) used computer tomography, or CT scan, techniques to study anatomical asymmetries and confirm earlier findings.

The purpose of these observations is served by noting that anatomical asymmetries are present in the physical structure of the hemispheres, just as evidence indicates functional asymmetry between them as well. Currently, there is not sufficient evidence to state exactly how these physical asymmetries relate to functional differences.

Methods of Studying Laterality

Surgical Procedures

Lesion studies

Many of the initial findings on laterality were based upon the examination of patients with cerebral lesions (i.e, damage to one or other of the cerebral hemispheres). This approach is still providing

useful data but a variety of other approaches have been developed to explore laterality effects.

Commissurotomy studies

Commissurotomy is a surgical procedure for intractable epilepsy which involves cutting the physical link (i.e., the corpus callosum) between the two cerebral hemispheres. This unique condition has been fertile ground for the study and clarification of laterality effects, and will be discussed later in some detail.

Hemidecortication studies

Hemidecortication is another medical procedure in which an entire cerebral cortex must be removed to treat otherwise fatal brain tumors. Patients subjected to this procedure continued to function, with some notable perceptual and behavioral deficits. The study of the nature of these deficits has contributed to our understanding of the functional specializations of the hemispheres.

Electrical stimulation

Electrical stimulation of the cortex has been used to map certain functions in order to minimize the debilitating effects of brain surgery (Penfield & Jasper, 1954; Penfield & Roberts, 1959). This procedure can be performed with a local anesthetic, thus allowing the conscious patient to demonstrate and report the effects of stimulation upon various parts of the brain.

Induced Asymmetry

Sodium amytal studies

Some persons (usually those who are left-handed) have RH specialization for language functions which is in contrast to the predominant LH specialization. To minimize speech dysfunction resulting from brain surgery, what has become known as the "Wada test" (named after the pioneer of this procedure) is used to determine lateral specialization of language. The procedure involves the injection of sodium amytal into a carotid artery, leading to a short period of anesthesia of the ipsilateral hemisphere. If the affected hemisphere is dominant for speech, it will totally arrest this capability for several minutes; otherwise, little or no effect upon speech is demonstrated. This procedure has allowed the study of one hemisphere in the (anesthetized) absence of the other, thus clarifying their respective functions.

ECT studies

Pratt and Warrington (1972) described a technique which involved the application of electroconvulsive therapy (ECT) to only one side of the head (in contrast to its usual bilateral application). Significant differences in behavior occurred depending upon the side stimulated. Results and implications related to these studies will be described later in this review.

Monitoring Brain Activity

Cerebral blood flow

Another medical procedure is based upon the relationship between activity in a certain area of the brain and increased blood flow in that area. The use of modern monitoring techniques has allowed the localization of blood flow increases to be associated with various kinds of activity (e.g., vision or speech). Lassen, Ingvar, and Shinkhj (1978) reported some hemispheric differences based upon this technique but indicated that there was a striking similarity in blood flow patterns even during highly lateralized activities such as speech. This may demonstrate the subtle nature of laterality effects and the limitations of physiological measurement techniques.

EEG studies

Another technique involves the monitoring of electrical activity in the brain (through the use of electroencephalograph [EEG] data). Hypotheses concerning hemispheric specialization can be drawn from the association of (localized) increased brain activity with specific kinds of activities. Donchin, Kutas, and McCarthy (1977) reviewed this technique and pointed to a number of methodological problems which may affect its reliability.

PET studies

Gur et al. (1983) also used positron emission tomography (PET) to measure laterality effects. This method measures increased cerebral glucose metabolism as an indication of activation. Such measurement

confirmed the traditional verbal (LH) / spatial (RH) relationship among dextrals. One advantage of this technique is that it allows exact location of the brain structures associated with given processing requirements.

Behavioral Techniques

Tachistoscopic studies

The tachistoscope is a device which can precisely control the presentation of visual information to experimental subjects. Based upon the finding that vision is split into right and left visual fields which are projected to the contralateral cerebral hemispheres, many researchers have utilized this device to study laterality. Commonly an assumption regarding lateral dominance is based upon greater accuracy or speed of recognition of information presented to one hemisphere relative to the same information presented (via the opposite visual field) to the other hemisphere.

Lateral eye movement

Day (1964) associated lateral eye movement (LEM) with attention, thought and anxiety variables. Many other researchers have used LEM as an indication of contralateral hemispheric activation (e.g., looking left as an indication of RH activation). Bakan (1969) noted that questions requiring analysis generally resulted in right lateral eye movement, and those involving spatial judgement resulted in leftward movement. More recent studies utilizing this technique will be reported later in this

review. See Gur and Gur (1977) for a review of this method, its validation and implications for laterality research.

Dichotic listening

The auditory system is not as precisely contralateral as the visual system, yet sounds presented to each ear simultaneously do appear to have preferred access to the opposite hemisphere (Kimura, 1961). The dichotic listening test is based upon this finding and has been used as a tool to examine cerebral specialization. For example, Kimura's findings showed that verbal material was most easily analyzed when presented to the right ear (with preferred access to the LH--recognized as specialized for linguistic functions in most subjects).

Dichhaptic testing

There is also a contralateral relationship between the cerebral hemispheres and the sensory-motor functions of the body (i.e., the left side of the body is controlled by the RH and the right side by the LH) (Kolb & Whishaw, 1980). This discovery led to a tactual version of the dichotic listening test which came to be known as dichhaptic testing. Generally, this involves the manipulation and/or manual identification of out-of-sight objects. Related studies have shown, for example, the superiority of the left hand in reading Braille for both blind and sighted individuals (Rudel, Denckla, & Spalten, 1974)--thus indicating a RH superiority for this type of spatial skill.

Psychometric Instrumentation

A "paper-and-pencil" approach to measuring brain laterality has been developed by Torrance and Reynolds (1980), Wonder and Donovan (1984) and Hermann (1982). These investigators have operationalized the available research findings into a multiple-choice format. David Loye (1982) also developed the Hemispheric Consensus Prediction (HCP) test which he used to do research on the relationship of brain laterality to the ability to forecast the future. Torrance and Reynolds have used their "Your Style of Learning and Thinking" (SOLAT) primarily for research on creativity. Wonder and Donovan have popularized their "Brain Preference Indicator" (BPI) in their book, Whole Brain Thinking, while Hermann has used his instrument to study laterality in terms of occupational profiles. The SOLAT and the BPI will be used in the study proposed herein.

This method has obvious advantages in terms of the ability to assess relatively large numbers of normal subjects. Because it is an objective and familiar method of assessment, psychometric measurement is also less likely to introduce elements of experimental contamination due to instrumentation or reactivity effects.

Evidence for Functional Asymmetry

Historical Overview

The study of the cerebral hemispheres of the human brain is over a century old. The idea that the apparent physical similarity belies notable functional differences is equally dated. As early as 1861, Dax

and Broca (cited in Kolb & Whishaw, 1980) initiated this research by studying the relationship of localized brain damage to the resulting loss of function. Marc Dax observed over 40 patients exhibiting verbal dysfunction associated with damage to the LH. During the same period of time, Paul Broca studied the case of "Tan"--a patient with an inability to speak who could write normally and comprehend language, and who suffered no impaired movement of lips or tongue. Inspection of the results of a post mortem examination of Tan led Broca to suggest an association between this type of verbal dysfunction (to be known as motor aphasia) and damage to the frontal lobe of the LH.

In 1874, Carl Wernicke (cited in Segalowitz, 1983) described a converse condition in which the patient was capable of fluent speech yet whose comprehension was impaired, resulting in meaningless utterances which retained correct grammar. This condition was also associated with damage to the LH.

These discoveries led to progress in mapping brain structure related to vision, hearing, touch, and motor control. Yet by the middle of this century the only firm hypothesis regarding brain function and its relationship to higher mental processes remained the association of speech with the LH in the great majority of dextrals. Most researchers thought that the LH was dominant for all higher functions and the RH (labelled as "minor") served only to silently relay information to the LH. Under this paradigm, to study the higher psychological functions and behavior of man was to study the processes of the LH.

Exception to this concept was not totally absent. Hughlings Jackson (cited in Segalowitz, 1983) proposed that the RH was equal or even

superior to the LH for visuospatial functions. Much later, a number of other researchers began to report results indicating RH superiority in certain functions (Hecaen & Angelergues, 1962; Hecaen, Penfield, Bertrand, & Malmo, 1956; Paterson & Zangwill, 1944; McFie, Piercy, & Zangwill, 1950).

Language Functions and Split-Brain Research

Much of the modern evidence for functional asymmetry has come from the study of "split-brain" patients. These patients underwent surgery involving the separation of the cerebral hemispheres (commissurotomy) by cutting the corpus callosum which connects them.

Van Wagenen and Harren (1940) pioneered this type of operation as a treatment for intractable epilepsy. As part of their study, psychological testing was conducted with these 26 patients and it was found that the operation had surprisingly little effect upon perceptual or motor performance (Akelaitis, 1941a, 1941b, 1941c, 1942a, 1942b, 1943, 1944; Akelaitis, Risteen, Herren, & Van Wagenen, 1942; Akelaitis, Risteen, & Van Wagenen, 1943; Smith & Akelaitis, 1942). Unfortunately, it also had little effect upon the patients' seizures. Later research indicated that more sophisticated testing techniques are required to detect the effects of the surgical procedure.

Joseph Bogen and Phillip Vogel suggested that Van Wagenen's procedure was not successful because it did not involve a complete disconnection of the hemispheres. Bogen and Vogel (1962) performed several complete commissurotomies and their hypothesis was confirmed. These "split-brain" patients became the focus of extensive assessment

because of the unique opportunity afforded to study the hemispheres in neural isolation from each other.

LH predominance in linguistic function was affirmed in the study of these patients. In tachistoscopic tests designed to present images to each hemisphere (the right visual field projects to the LH; the left visual field to the RH), patients easily identified words and objects projected to the right visual field; they could not do so when the stimuli were projected to the left visual field.

The hemispheres also control contralateral sides of the body. Dichhaptic testing revealed that objects felt with the right hand could be named; those felt with the left hand could not be named but could be nonverbally identified by pointing (Gazzaniga, 1970; Gazzaniga & Sperry, 1967).

RH language abilities

Gazzaniga, Volpe, Smylie, Wilson, and LeDoux (1979) described a case which indicated a possible RH speech capacity. This case involved a split-brain patient who was 15 years old when the surgery was performed. Over two years later, this patient demonstrated an ability to name (not with complete accuracy) words and pictured objects projected to the RH. This finding was expanded by Sidtis in context of a "staged" commissurotomy ("Two stage surgery," 1981). In this procedure the corpus callosum was partially sectioned in an initial operation, followed by a second operation (two months later) to complete the separation. Sidtis speculated that the first stage of this procedure invoked a compensatory reaction that enhanced right hemispheric processing of language.

Patients who went through the first stage of this procedure demonstrated abilities not seen in subjects of single stage commissurotomy. When an image was projected to the RH, they could answer questions regarding the context and nature of the image even though they could not initially name it.

In contrast to some of the initial research, Johnson (1984) demonstrated that split-brain patients may recover a degree of the communication between hemispheres some years after the surgery. A number of other researchers had earlier suggested the ability of such patients to give verbal reports of information projected to the RH (Teng & Sperry, 1973; Trevathen & Sperry, 1973).

Caution in interpretation

Research with split-brain patients must be carefully interpreted because of the nature of the malady which justified the procedure (i.e., intractable epilepsy). There is some evidence (Ojemann & Whitaker, 1978) that language representation is highly variable among epileptics, thus perhaps leading to an overestimation of right hemispheric language functions among normals.

Other Left Hemispheric Functions

There are a number of research methods which have been utilized to study brain laterality in normal subjects. Lateralization is less pronounced than in split-brain patients but results have consistently indicated hemispheric differences.

Nebes (1974) and Lomas (1980) noted that the LH has sole control over the muscles utilized to produce speech. Molfese (1978a, 1978b, 1980) also argued that elements of speech perception are unilaterally processed by the LH. Other studies indicated that verbal coding processes (Seamon, 1974; Seamon & Gazzaniga, 1973), category matching (Urcuioli, Klein, & Day, 1981) and consonant-vowel recognition (Springer, 1977) are also functional specialties of the LH.

A stronger case has been made for LH language production than for language comprehension (Searleman, 1977). Nonetheless, a number of researchers have affirmed the unilateral representation of language in the LH (DeRenzi, 1978; Gazzaniga and LeDoux, 1978; Kinsbourne, 1978; Klatzky, 1970; Marin, Schwartz, & Saffran, 1979).

Analytic/holistic distinction

There is some evidence to support the viewpoint that a more fundamental process underlies LH language specialization. Segalowitz, Bebout and Lederman (1979) concluded that analysis is such a process. They found that language tasks which required analytic processing primarily engaged the LH, whereas those requiring simple recognition of spatial form were mediated by the RH. The work of Tzeng, Hung, Cotton and Wang (1979) supported this finding. They found that the RH was superior in the recognition of single Chinese logographs while the LH was superior when double characters (presumably requiring analysis to establish relationship, context and so forth) were presented.

Later research called this distinction into question. Justine Sergent reported results indicating that an even more fundamental

delineation may exist ("Canadian study," 1983). The LH was found to be better at processing information of a complex or detailed nature, requiring high-resolution skills. The RH, on the other hand, predominated in processing larger, less detailed types of data with low resolution requirements. Sergent argued that both hemispheres are capable of analytic and holistic perception, and that the resolution requirements of the input may determine which hemisphere is more effective at processing.

The major emphasis of research on the LH has involved its linguistic functions. There is another body of research, however, which has explored a number of other LH functional characteristics.

Studies of voluntary movement

Liepmann and Maas (cited in Corballis, 1983) presented some of the initial evidence concerning the relationship of the LH and skilled voluntary movement. They associated LH damage with a class of disorders, known as apraxias, which involve impairment of learned, voluntary movement not attributable to weakness, tremor, intellectual dysfunction, or lack of cooperation. This association was confirmed much later by the work of Heilmann (1979). Kimura and Archibald (1974) suggested that the problem was fundamentally an inability to properly sequence actions. For example, they demonstrated that apraxic patients could copy static hand and arm positions, but could not duplicate movements. Lomas (1980) and Lomas and Kimura (1976) generally supported this view but argued for unilateral LH specialization for only a limited set of rapid, nonvisually guided movements.

Serial/parallel distinction

Cohen (1973) originally proposed a distinction between serial (LH) processing and parallel (RH) processing of information. In serial processing, processing time increases as a function of the number of elements to be processed; in parallel processing, processing time is independent of the number of elements.

This particular distinction of function has been more recently questioned by Polich (1982), who suggests that such delineations should not be made without considering the variance introduced by the nature of different input stimuli (e.g., spatial tasks requiring featural analysis may be processed in parallel by the LH).

Some researchers have argued that serial processing is a key element of executive, planning, and decision functions (Gazzaniga, 1974; Gazzaniga & LeDoux, 1978; Levy, 1974; Nottebohm, 1979, 1981). There is general consensus that these are LH specialties and some believe them to be unilaterally distributed (Gazzaniga & LeDoux, 1978; Nottebohm, 1979).

Once it became evident that the verbal/nonverbal dichotomy was not comprehensive enough to explain experimental results, the search for more fundamental modes of specialization emerged. The aforementioned serial/parallel distinction is an example of this. This search for dichotomous explanations is illustrated by Bogen's propositional / appositional distinction.

Bogen (1969b, 1977) proposed that two "modes of thought" were derived from hemispheric differences--two different ways of processing information. This model will be examined later in this literature review in the context of models proposed by other researchers . First,

however, an overview of the research related to RH function will be discussed.

Right-Hemispheric Specialization

The traditional terminology of brain laterality provides a perspective on how the RH has been viewed in the past. Until recently, the LH was known as the "dominant" or "major" hemisphere; the RH being designated as "nondominant" or "minor." J.Z. Young (1962), an eminent zoologist, even speculated as to whether we need "two brains" and if the RH might not be a "vestige." More recent evidence has helped clarify the importance of RH function.

Early studies

Over a century ago, Hughlings Jackson (cited in Segalowitz, 1983) speculated that since the function of expression was apparently associated with the LH, perhaps perception might be associated with the RH. Some time afterwards, Jackson described a case of what he termed "imperception"--the inability to recognize familiar people and places and spatial disorientation. In 1891, Freud coined the term "agnosia" to describe disorders involving problems of recognition, discrimination, and spatial orientation. A review of the relationship of cerebral function to various agnosias may be found in Rubens (1976).

Studies involving patients with brain damage led to the clarification of RH functions. Patients with RH damage demonstrated measurable deficits related to basic perceptual functions such as figure-ground determination (e.g., Russo & Vignola, 1967; Teuber & Weinstein,

1956), visual localization (e.g., Scotti & Spinnler, 1970), mental rotation (Ratcliff, 1979), memory for familiar faces (Hecaen & Angelergues, 1962), and judgement of line direction (Benton, Hannay, & Varney, 1975).

Tachistoscope studies with normal persons also confirmed the association of the RH with perceptual abilities. Results indicated a RH specialization for delineation of nonsense shapes (Hellige, 1978), dot patterns (Kimura, 1966), facelike patterns (Patterson & Bradshaw, 1975), depth perception (Durnford & Kimura, 1971), color (Davidoff, 1975), contrast (Davidoff, 1976), and line curvature (Longden, Ellis & Iversen, 1976).

Dichotic listening tests have shown a RH specialization (indicated by a left-ear advantage) in the perception of melody (Kimura, 1964), musical pitch (Blumstein & Cooper, 1974), harmony (Gordon, 1970), and timbre (Kallman & Coballis, 1975). Bever and Chiarello (1974) and Wagner and Hannon (1981) conducted experiments which indicated that melody recognition was mediated by the LH in experienced musicians (perhaps indicating a more analytical approach) and by the RH in untrained listeners. Johnson (1977), Davidson and Schwartz (1977), and Hirschowitz, Earle, and Paley (1978) confirmed this difference based upon musical training.

Face recognition

The RH seems to play a complementary role to the LH when it comes to the recognition of human faces. Based upon the review of apparently conflicting experimental evidence, Benton (1980) proposed that the RH

plays the primary role in the recognition of both familiar and unfamiliar faces but that the LH contributes significantly to this ability when a memory element (e.g., familiar or famous faces) is introduced. Sergent and Bindra (1981) explained the differences in terms of task requirements--the RH specializing in holistic perception and the LH in perception requiring analysis.

Ross-Kossak and Turkewitz (1984) reported that some subjects would shift processing between hemispheres as they became more familiar with facial stimuli. Those subjects beginning with a RH advantage, for example, would shift to LH processing and then back to the RH. The authors suggested that these shifts correspond to an initial undifferentiated holistic perception (RH), a second stage involving the analysis of features (LH), and then the inclusion of such features into a gestalt (RH).

Other studies

Hemispheric differences have also been documented in word recognition studies. Bryden and Allard (1976) demonstrated that LH superiority in the recognition of tachistoscopically presented words tended to shift towards RH specialization as the typeface became more complex (e.g., script). L.J. Harris (1980) indicated that a RH advantage may be demonstrated by the left hand preference of most blind persons in the reading of Braille. Similarly, Karavatos, Kaprinis, and Tzavaras (1984) documented a shift towards RH processing as congenitally blind children progressed in learning Braille, presumably reflecting adaptation to the task requirements of the system.

Split-brain patients provided dramatic evidence concerning the manipulospatial skills of the RH (Gazzaniga, Bogen, & Sperry, 1962; LeDoux, Wilson, & Gazzaniga, 1977). Such patients could not draw a three-dimensional object with their right hand but could rather easily do so with their left hand. Similarly, the left hand could easily replicate block patterns--a task that the right hand had great difficulty in attempting. LeDoux, Wilson, and Gazzaniga (1977) conducted a series of related experiments which demonstrated that the difference was not one of perception since geometric designs were easily identified when projected to either hemisphere.

There is also a body of experimental evidence which relates RH function to emotions and to creativity. These studies will be reviewed in distinct sections to follow.

Skeptical viewpoints

The evidence presented in this review consistently supports a view upholding the validity and significance of cerebral laterality. This view, however, is not subscribed to by all. In 1977, Daniel Goleman wrote an article on "Split-Brain Psychology: Fad of the Year." Goleman warns that "with its appealing simplicity, brain laterality theory has been seized upon to explain almost everything under the sun" (p. 89).

In a similar vein, Schwartz and Kirsner (1984) suggested that "much of today's laterality research can be compared with the phrenology of the last century" (p. 66). They cite problems of sampling, reliability, and validity of measurement which, in their view, contaminates most of the available research. In this researcher's view, such skepticism is

healthy to the degree that suggests caution in the application of speculative research.

Nonetheless, there is general consensus concerning the principle of some degree of cerebral specialization. A lively debate continues over the degree of unilateral specialization and the formulation of a model to explain laterality effects. The next section will review some of the models proposed to explain processes associated with brain laterality.

Models of Brain Laterality

Max Allen (1983) reviewed the literature on laterality and categorized it in terms of five distinct models: (a) unilateral specialization, (b) cooperative interaction, (c) negative interaction (inhibition), (d) parallel processing, and (e) functional allocation. A description of each of these models is presented in the following sections.

Unilateral Specialization Model

As may be evident from the review of the literature presented thus far, the unilateral specialization model predominated among early theorists. This model holds that there are absolute differences (i.e., a strict dichotomy) in the functions of the hemispheres. The localization of language is the most fervently proposed example of this theory. Bogen (1969b) has been a prime example of this viewpoint with his "propositional" (i.e., capable of using words in the formulation of propositions--typically a LH function) and "appositional dichotomy. He

went so far as to suggest "two modes of thought," exemplified by the dichotomies presented in Table 2 (cited in Edwards, 1979, p. 34).

Table 2

Selected Dichotomies Related to Hemispheric Laterality

(LH)	(RH)
intellect	intuition
convergent	divergent
abstract	concrete
analytical	relational
lineal	nonlineal
objective	subjective

Various forms of a verbal/nonverbal dichotomy have been upheld (DeRenzi, 1978; Lenneberg, 1967; Kinsbourne, 1978). However, this position has given way, to some extent, in the face of mounting evidence concerning the role of the RH in language (Searleman, 1977).

Speculation concerning the unilateral representation of spatial abilities has been more cautious (Moscovitch, 1973). In general, the trend in the theory of laterality has been away from a strictly unilateral viewpoint.

Cooperative Interaction Models

The concept of cooperative interaction between the hemispheres is based upon the assumption of a bilateral specialization of skills and has been proposed by a number of investigators (e.g., Broadbent, 1974; Chiarello, 1980; Gazzaniga & LeDoux, 1978; Marshall, 1981; Sergent, 1982; Wolff, 1980; Wolff & Cohen, 1980). This model suggests that both hemispheres function simultaneously and jointly contribute to task performance. Luria (1966, 1973) suggested that such cooperation is typical of psychological activity as well as language, spatial, and motor functions.

This model has been used to explain a variety of research findings related to attention (Ellenberg & Sperry, 1980), face recognition (Sergent & Bindra, 1981), verbal tasks (Broadbent, 1974), and rhythmic tasks (Peters, 1977).

There is some debate concerning whether the hemispheres perform the same function simultaneously (e.g., Guiard & Requin, 1977) or whether they contribute distinct elements of the function (e.g., Alwitt, 1981; Sergent & Bindra, 1981). In support of the latter view, Nettleton and Bradshaw (1983) presented a distinction of processing preference based upon the relative efficiency of semispecialized hemispheres.

Negative Interaction (Inhibition) Models

The negative interaction model also posits a bilateralization of function but suggests that the hemispheres act to inhibit each other. Some studies have suggested a inhibition of the RH by the LH when it

comes to language functions (Moscovitch, 1976; Kirsner, 1980). Conversely, Bogen (1969a) proposed that the RH inhibits the LH when it comes to visuospatial functions.

Galin (1974) suggested that the LH controls language functions and overt behavior--mediating the conflict between the hemispheres by inhibiting the connections (commissure) between them. Such a hypothesis has interesting implications for psychological function and will be discussed fully in a later section of this review.

Kinsbourne (1970, 1974a, 1974b) proposed a theory of bilateral inhibition. Of special interest are the implications for research related to lateral eye movement as an indicator of hemispheric activity. Kinsbourne's model suggested that when the inhibitory relationship between hemispheres is balanced, a person's gaze will be directed straight ahead; attention directed to either side indicates inhibition of the ipsilateral hemisphere.

Raquel and Rubin Gur (1977a) reported that lateral eye movement to the right occurred 64% of the time following verbal questions but only 31% of the time after spatial questions. Blakeslee (1980) concluded that people may be classified as to their habitual cognitive mode (i.e., as right-movers, left-movers, or bidirectionals) and that this may partially determine aptitude and personality variables.

Parallel Processing Models

Another school of thought maintains that the hemispheres operate simultaneously yet independently (i.e., in parallel). In a variation of this model, Dimond and Beaumont (1974) proposed that initial cerebral

processing occurs in tandem between the hemispheres, followed by a later stage of cooperative interaction. They also suggested that the parallel component may involve duplicate processing for simple tasks but some degree of simultaneous specialization for more complex tasks.

Moscovitch, Scullion, and Christie (1976) proposed a similar parallel model for face recognition. They suggested that the initial stage of processing is bilateral but did not specify whether it is parallel, interactive or inhibitory. The second stage involves parallel processing by each hemisphere according to its characteristic cognitive mode. This model has also been applied to the perception of speech (Crowder, 1973; Darwin, 1974; Liberman, 1974; Wood, 1975).

Functional Allocation Models

A final model of laterality assumes bilateral capability but, in normal processing, the allocation of certain functions to given hemispheres. Three different types of allocation models have been proposed: (a) input models, (b) output models, and (c) switching models.

Input models

Levy (1974) proposed an input model based upon allocation directed by attention. According to this theory, if attention directs processing to the hemisphere appropriate to the task to be performed, then processing proceeds normally. If, on the other hand, processing is directed to the hemisphere not specialized for the task at hand, input is then redirected to the other hemisphere. This theory would explain the

differential in reaction time which forms the basis of results from tachistoscopic and dichotic listening procedures.

Another related input model suggests that one or other of the hemispheres may be "primed" for input and that this hemisphere assumes processing responsibility (Beaumont, 1981; Bowers & Heilman, 1980; Moscovitch, 1979; Segalowitz & Chapman, 1980). Hines, Sawyer, Dura, Gilchrist, and Czerwinski (1984) reported that the LH can be primed in terms of semantic categories. Therefore, reaction times were shorter for words which followed directly after other words within the same semantic category (e.g., "cat" following "dog" or "apple" following "orange"). No such effect was reported for the RH.

There is marked disagreement concerning the sources and consequences of this priming. One theory (Moscovitch, 1979) holds that input is processed in accordance with the primary cognitive mode of the primed hemisphere. Thus, if the LH is primed, input would be processed verbally. Not all studies have confirmed predictions based upon this model (Moscovitch & Klein, 1980; Wexler & Heninger, 1980).

In a contrasting model of allocation, Levy and Trevarthen (1976) concluded that hemispheric processing is under volitional control and is influenced by cognitive expectations. They suggested that the nature of the task and hemispheric specialization only indirectly affect hemispheric processing.

Output models

Output models suggest that the allocation of function occurs in the last stage of processing. These models are not concerned with

localization of processing prior to output and, in some cases, propose that processing may occur in a hemisphere unrelated to the allocated output system (Dimond, 1974).

Switching models

Switching models allow for a back-and-forth allocation of processing between the hemispheres (Whitaker & Ojemann, 1977). These models are promising but not widely held because of their complexity and the questions they raise concerning the stimulus for, and the mechanism of, the switching process. Much of the current popular literature assumes the possibility of a volitionally-controlled type of switching (e.g., Edwards, 1979; Wonder & Donovan, 1984).

Summary of Models

One can readily see that a wide range of speculation surrounds the formulation of a model to explain observed laterality effects. As research techniques and instrumentation become more sophisticated, evidence may more clearly point to a predominant explanation.

It should be noted that the two laterality instruments chosen for this study (described in Chapter III) assume a view of laterality which posits a continuum of preference for hemispherically-specialized activities. Since no assumptions are made concerning the underlying dynamics of these preferences, such measurement could be included within the framework of any of the models thus far described.

One of the complications inherent in the development of theory is the identification of intervening variables which influence laterality. The next section will discuss some of these factors.

Variables in Cerebral Laterality

Handedness

The specialization of the LH for linguistic functions for dextrals is well established. For some time it was thought that the cerebral organization of sinistrals was a mirror image of the dextral's (Penfield & Roberts, 1959; Roberts, 1968). A review of the literature by Satz (1980) led to the conclusion that language skills are distributed bilaterally in many (he estimated 40 %) sinistrals. Other studies utilizing the Wada technique (Milner, Branch, & Rasmussen, 1964; Rasmussen & Milner, 1977; Rossi & Rosadini, 1967) projected a 70 % LH speech specialization for sinistrals (with 15 % RH and 15 % bilateral) compared with a 96 % frequency for dextrals (with 4 % RH). A study by LeMay and Culebras (1972) found anatomical differences in sinistrals supporting bilateral linguistic representation.

A number of studies have concentrated upon discriminating between those sinistrals who have RH language specialization and those who have LH specialization. Some researchers (Hecaen & Sauguet, 1971; Zurif & Bryden, 1969) have suggested that individuals with a familial history of left-handedness are more likely to exhibit RH specialization. However, these results have not been consistently replicated (Lake & Bryden, 1976).

Levy and Gur (1980) suggested that perhaps 50 % of sinistrals have reversed laterality while the remaining 50 % are bilateral. They also proposed that handwriting posture may be used as a factor to discriminate between these groups, with sinistrals utilizing noninverted handwriting posture being more likely to display reversed laterality. Other researchers have attempted this delineation in terms of strength of left-handedness (i.e., pure versus mixed) (Annett, 1967, 1972, 1975) and handwriting position (Levy & Nagylaki, 1972; Levy & Reid, 1976, 1978).

Definitive results related to lateralization of language in sinistrals are not yet available, but it may be safely stated that sinistrals are less likely to exhibit clearcut laterality.

Ocular Dominance

In addition to a dominant hand, most people have a dominant eye (i.e., the eye chosen for use in tasks allowing the use of only one eye). Coren and Kaplan (1973) investigated a variety of eye dominance measures and, as a result, proposed three types: sighting dominance, acuity dominance, and sensory dominance. Porac and Coren (1976) proposed sighting dominance as the only one significant in terms of underlying laterality and estimated that 67 % of the population have a right-eye sighting dominance. This dominance factor is significant because, in contrast to handedness, no social pressure has been exercised which would contaminate preference. It might, therefore, exhibit a more reliable relationship to lateralization. Levy and Gur (1980) related eye dominance to laterality and suggested that a contralateral relationship

of ocular dominance to language representation may be an indicator of more differentiated lateralization.

Sex Differences

It has also been suggested that there is a sex difference in the way language and visuospatial functions are represented in the human brain (Lansdell, 1961; McGlone, 1977, 1978; McGlone and Kertsz, 1973). A body of research has long documented that males outperform females on tasks which require visuospatial skills (e.g., Sandstrom, 1953; Stafford, 1961; Thurstone, 1938; Witkin, 1949) and that females excel on tasks related to verbal skills (e.g., Hutt, 1972). A number of researchers have related these differences to underlying cerebral organization (Harris, 1978; Hutt, 1972; Maccoby & Jacklin, 1974; McGee, 1979; Sherman, 1974).

Two opposing points of view have been proposed concerning the relationship of sex to brain laterality. Buffrey and Gray (cited in Segalowitz, 1983) suggested that the male brain is more symmetrically organized for both verbal and spatial functions. This view, however, has less support than the opposite hypothesis--that the adult male brain is more asymmetrically organized for verbal functions (McGlone, 1977), spatial functions (Harris, 1978; McGee, 1979; Witelson, 1976, 1977), or both (Bryden, 1979; Hutt, 1979; McGlone, 1977, 1978). In a review of related literature, McGlone (1980) concluded that the evidence supported sex differences in the asymmetrical organization of the adult brain, primarily in support of greater asymmetry in the male.

Cultural Factors

Bilingual and cultural factors have also been shown to influence laterality. Vocate (1984) compared a group of bilingual Native American children to a group of monolingual Anglo children. She found the bilingual children to be less lateralized and to have cerebral symmetry for receptive language processing. Albert and Obler (1978) had earlier made the same type of observation with regard to bilinguals. The finding of cerebral symmetry is interesting in light of earlier research indicating universal RH language processing among monolingual Native American speakers (Hynd & Scott, 1980; Rogers, TenHouten, Kaplan, & Gardiner, 1977).

In a chapter on "Barriers to Effective Cross-Cultural Counseling," Derald Sue (1981) cited the work of Robert Ornstein and concluded that the LH orientation of American schools of counseling may inhibit work with persons (e.g., American Indians or Orientals) whose culture has more of a RH orientation to time and cause-and-effect relationships. This leads us to examine the counseling-related implications of laterality in a more direct manner in the following sections.

Counseling-Related Implications

Counseling is concerned with a broad range of factors related to human growth and development. Creativity in self-expression and in facing the challenges of life has long been such a factor. Indeed, the developer of one of the instruments utilized in this study (i.e., the SOLAT), E. Paul Torrance, is a pioneer in this area of study.

Occupational and affective factors are obvious areas directly related to the role of the counselor. Lastly, counseling theory and practice are based upon an understanding of the human personality, how it functions and changes; anything contributing to this understanding is valuable information for counselors. The following sections will explore the literature related to each of these general categories.

Creative Functioning

A number of researchers have drawn parallels between the creative process and hemispherical laterality. E. Paul Torrance has recently turned his attention to this area of study. Torrance and Reynolds (1980) developed an instrument to measure laterality--"Your Style of Learning and Thinking" (SOLAT). Correlation with a variety of measures of creativity (Torrance, 1982) has demonstrated a consistently positive correlation between creativity and RH preference; and a consistently negative correlation between creativity and LH preference. These results confirm a general association between creativity and RH functioning (Olson, 1977; Wheatley, 1977).

Two processing modes

Many views of the creative process have involved a discrimination between two modes of information processing. Blakeslee (1980) proposed a distinction between "visual" and "verbal" thinking. While both types of thinking are required for creative functioning, verbal (LH) thinking is generally too strictly circumscribed and structured to facilitate creative achievement. The visual (RH) thinking process is not delimited

by time, logic, reason, and sequence; it provides the flexibility required for discovery and innovation. This particular difference was first observed and verified by Galin and Ornstein (1974), who found that learning and memory tasks were processed either verbally (LH) or visually (RH) by split-brain patients, depending upon which hemisphere was processing the input.

Osborn (1963) used the terms "critical intelligence" and "creative intelligence" to describe the elements of creative problem solving. Critical intelligence corresponds closely to specialized LH functioning; creative intelligence to RH functioning. Osborn created techniques for utilizing each type of intelligence at appropriate points in the problem-solving process. Brainstorming, for example, involves the suspension of LH functions (e.g., judgement, evaluation, critical reasoning) to help activate a creative flow of ideas. These LH functions are called upon, later in the process, to evaluate the ideas thus generated. LH functioning could therefore be inhibitory during one phase of the creative process (i.e., brainstorming), yet facilitative during another phase (i.e., evaluation of alternatives).

Edward de Bono (1970) made a distinction between "vertical" and "lateral" thinking. Vertical (LH) thinking is analytic, sequential, rational; lateral (RH) thinking is by nature a holistic, intuitive, visuospatial process. The cultivation of lateral thinking is seen as the key to creative problem-solving and is contrasted with the complementary, culturally predominant, vertical style of thinking.

Integrated functioning

Sanders and Sanders (1984) confirmed the importance of integrated shifting between LH and RH functions, with creativity as "the product of their merger" (p. 25). A number of other researchers (e.g., Sagan, 1977; Garrett, 1976; Parnes, 1977) reflected a similar point of view concerning the requirement for balanced cerebral interaction for optimal creative functioning.

Stages of creativity

Graham Wallas' (1926) classic study of thought and creativity identified four sequential stages of the creative process: (a) preparation, (b) incubation, (c) illumination, and (d) verification. Preparation is a stage which involves systematic investigation and the collection of data, utilizing typically LH functions. Incubation is a gestation period during which unconscious (RH) processes sort through the information which has been gathered. Illumination is the point of inspiration, the moment of discovery, the achievement of intuitive (RH) functioning. Verification is then invoked to subject the illumination to the disciplined scrutiny of logical and reasoning (LH) functions. More recently, Ned Hermann (1982) presented a model of "Whole Brained Creativity" based upon the association of Wallas' model with hemispherical functioning. Again, the dynamic shift between LH and RH functions is evident.

Hemispheric shifting

Betty Edwards (1979) focused upon the possibility of a cognitive shift between LH and RH modes of processing. As part of a program to teach drawing skills, she developed a series of exercises designed to facilitate a shift from LH to RH dominance. Such a shift was proposed as the key to artistic perception and expression. Because of the predominance of LH functions in modern, technological society, Edwards proposed that such a shift towards the RH is required to achieve "whole-brain" functioning. A number of other researchers have concurred with this judgement of a societal bias towards LH function (e.g., Galin & Ornstein, 1973; Ornstein, 1976; Sperry, 1974) and the need for more balanced cerebral development.

The notion that volitional control may be exercised to develop RH functions was the basis for Wonder and Donovan's book, Whole-Brain Thinking. They followed Edwards' approach in the use of a series of exercises to stimulate RH activation, in this case to enhance job performance. This will be discussed further in the section on occupational implications of laterality.

There are obvious parallels between concepts of creative functioning and hemispherical lateralization. Such parallels provide a fertile ground for research to clarify the relationship between these concepts.

Occupational Implications

Jacquelyn Wonder and Priscilla Donovan (1984) have written what their publisher has claimed (on the book's flap) to be "the first practical business book based on Roger Sperry's Nobel Prize-winning

research on the split-brain theory." In the best seller, In Search of Excellence, Peters and Waterman (1982) extolled the obsolescence of the Rational (LH) Model of management and noted the intuitive (RH) strengths of successful business leaders. Both of these popular works represent the practical application of brain research to the modern world of business management.

Shifting brain-styles

Wonder and Donovan (1984) suggested that both individuals and organizations have a characteristic brain-style (on a continuum from LH to RH). Individuals can shift between the brain's hemispheres to achieve "peak job performance." Such shifts may be facilitated by a series of exercises outlined by the authors and presented in Table 3.

Table 3

Methods Suggested for Shifting Brain-Styles

Method	Description	Page
Brainstorming	Freeing, then evaluating ideas	67
Cinematics	Envisioning scenes	84
Inside outs	Turning the facts upside down	100
Suspenders	Overstimulating the left to free the right	111
Hearings	Moving into either brain-style at will	125
Uprights	Shifting left when the situation demands	136

Note. Abstracted from Whole-Brain Thinking by Wonder and Donovan (1984).

Job compatibility

Agor (1983) stressed the importance of RH skills in management training--skills largely ignored in favor of LH skills. He suggested that "right brain skills appear to be particularly useful in such key occupations as personnel, health, public affairs/relations, intelligence/crisis management, and advertising/marketing--where imagination, creativity, and other subjective skills are demanded" (p. 78). In addition, Agor stated that the placement of RH dominant personnel into such positions would "significantly increase productivity as well as personal job satisfaction" (p. 78).

Organizational relationships

Results of Agor's (1983) survey indicated that top managers relied more upon intuitive (RH) skills in decision-making than did middle and lower level managers. Managers in health, general administration, and personnel scored above average on the intuition scale, while law enforcement and military personnel scored below average. Also, as a group, women scored significantly higher than men.

Agor (1983, p. 79) also presented a table relating "brain-styles" to (a) type of organization, (b) emphasis of management style, (c) effectiveness in different settings, (d) emphasis upon different applications, and (e) occupational specialties. This work actually analyzed hemispheric preferences at an organizational level.

Decision styles

Taggart and Robey (1981, p. 190) also focused upon the relationship of laterality to management. They presented a model of decision style which integrates Jung's theory of psychological type with laterality variables. On a continuum from LH dominant to RH dominant, they proposed the decision styles and representative occupations presented in Table 4.

Table 4

Decision Styles and Laterality

Decision style	Representative occupation
Sensation/Thinking (ST)	Technician
Intuition/Thinking (NT)	Planner
Sensation/Feeling (SF)	Teacher
Intuition/Feeling (NF)	Artist

The ST decision style is closest to the LH pole and represents management based upon logical, sequential, objective, causal, and analytical factors. The NF style is closest to the RH end of the continuum and is typical of management based upon intuitive, subjective, affective, and inductive factors. Taggart and Robey suggested that management education must retain the traditional LH curriculum but should balance it to include RH skills and strategies.

Somewhat earlier, Mintzberg (1976) published an article in the Harvard Business Review which related LH strengths to planning activities and RH strengths to management. He concluded that both types of skills

are to be respected and that caution should be exercised to determine the appropriate application of each.

Hermann (1982) developed a "dominance profile" which utilized both cerebral and "limbic" dimensions. He placed occupations such as accounting and middle management in the LH realm; entrepreneurs and social workers were placed on the RH side of the ledger. Hermann also indicated that the understanding and utilization of such concepts of laterality in relationship to work tasks allow the manager to "not only design the task appropriately, but . . . [also to] select and direct the right individual to do that work" (p. 82).

Coulson and Strickland (1983) utilized Hermann's concepts in a study of chief executive officers and superintendents of schools. Chief executive officers showed strengths closely related to RH skills: integration, creativity, and innovation. The superintendents tended more towards LH skills of organization, planning, and administration. George Prince (cited in Coulson & Strickland, 1983) associated LH modes of thought with a "safekeeping" personality style skilled at analysis, control and judgement. Using Prince's model, Coulson and Strickland predicted that "superintendents would be more likely to respond to difficult problems with more traditional, conservative, safekeeping approaches by implementing strategies and policies that have worked in the past" (p.172).

Coulson and Strickland argued that innovative and creative (RH) solutions are what is truly needed in such a situation. If the authors' hypothesis is valid, the significance (and liabilities) of a typical processing mode for a given occupation can be readily seen.

Occupational differences

Goodspeed (1983, p. 30) presented a list of occupations classified by Hermann's occupational profile. Some of the occupations are listed in Table 5.

Table 5

Occupations Classified by Hemispheric Orientation

LH oriented	RH oriented
Lawyers	Artists
Technologists	Top Executives
Bookkeepers	Dancers
Administrators	Politicians
Researchers	Policymakers

David Loye (1982) presented evidence to indicate that careers utilizing skills of prediction may require a more "balanced-mind" approach than others. His research suggested that effective prediction is facilitated by such a balance between LH and RH functions.

In a study comparing the cerebral blood flow (CBF) of English and architecture majors (while at rest), Dabbs (1980) found that English majors have greater CBF in the LH; architecture majors in the RH. This presumably reflects a preference to activate one hemisphere over the other.

Influence of training

There is also some evidence to indicate that occupational training may influence the mode by which information is processed by the brain. Bever and Chiarello (1974) found that musicians processed musical sounds with the LH while nonmusicians utilized RH processing. It was assumed that such training led to a more analytical (LH) approach--that sounds which must be naively absorbed by nonmusicians would have critical meaning to persons trained in its nuances. Thus training may influence hemispheric processing just as processing may influence job performance.

Affective Processes

The preponderance of laterality research related to higher-level functioning has focused upon cognitive processes. There is, however, a substantial body of data which relates hemispherical processes to affective processes as well.

Emotional perception

A number of studies have presented evidence of cerebral laterality in relationship to the recognition of emotional stimuli. Wechsler (1973) studied subjects with RH damage and found that story recall was impaired when the story had emotional content. Heilman, Scholes, and Watson (1975) confirmed this association when they found impaired judgement concerning the emotional mood, but not the content, of spoken sentences presented to RH damaged subjects. It has also been reported that such subjects had difficulty in expressing emotions through normal verbal inflections (Ross & Mesulam, 1979; Tucker, Watson, & Heilman, 1976). In

a related study, Ley and Bryden (1982) conducted research on normal subjects and found a RH advantage for identifying emotional tone and a LH advantage for identifying content of spoken sentences.

Suberi and McKeever (1977) conducted a tachistoscopic study involving the memorization and recognition of emotional and nonemotional human faces; they found a RH advantage in recognition of emotional faces. In a similar study, Strauss and Moscovitch (1981) required subjects to indicate whether two pictures (presented simultaneously to opposite visual fields) matched each other. A RH advantage was found when the pictures matched but not when they were different. Benowitz et al. (1983) also later confirmed the role of the RH in the judgement of facial expressions.

Using lateral eye movement as an indicator of contralateral hemispherical activation, Schwartz, Davidson, and Maer (1975) found a direct correlation between the emotional valence of questions directed to subjects and the subjects' left lateral eye movements. Ley and Bryden (1979) amplified these findings by establishing a correlation between the degree of emotion exhibited by the stimulus and the measured RH advantage--the advantage increasing as the emotional valence (either positive or negative) increased. In a related study, Natale, Gur, and Gur (1983) confirmed a RH advantage for perceiving and judging the valence of emotions.

Emotional expression

There is a general consensus regarding RH predominance in emotional perception. Emotional expression is another area in which some

interesting research has been done. Several studies have reported results related to the asymmetries of facial expressions. When frontal photographs of subjects were cut down the middle and two composites were made (one from two left sides and one from two right sides--one side of each pair being photographically reversed), the left side composites were consistently judged as more emotional. This finding was assumed to reflect the contralateral connection between the RH and the left side of the face. These results were confirmed in similar studies (Borod & Caron, 1980; Moscovitch & Olds, 1982). Moscovitch and Olds, however, found this asymmetry only in dextrals, further supporting a connection with cerebral laterality.

Clinical evidence

Some clinical evidence is also supportive of the association of brain laterality and affective factors. Classifying college students according to hysteric and obsessive-compulsive scales, Gur and Gur (1975) and Smokler and Shevrin (1979) reported greater frequency of left lateral eye movement (i.e., RH activation) among those classified as closer to the hysteric category. Since emotional display is key to hysteric behavior while obsessive-compulsives are thought to exert more control over their emotions (Shapiro, 1965), these results may forge a link between emotional expression and RH processing.

Another source of clinical evidence comes from the study of individuals with unilateral brain damage. Research by Gainotti (cited by Bryden, 1982) reported upon 150 such cases. Catastrophic reactions (e.g., crying, swearing, anxiety reactions) were more common for LH

damage (62 %) than for RH damage (10 %). Indifference reactions (e.g., explicit lack of concern, joking, minimization) were more common for RH damage (38 %) than for LH damage (11 %). These results were confirmed in a later study by Gainotti (1972), again indicating the RH specialization for emotional expression.

Some researchers utilizing the Wada technique have reported aftereffects which relate emotion to hemispherical function (e.g., Rossi & Rosadini, 1967). If the LH was anesthetized, depressive-catastrophic reactions followed its reactivation. In contrast, anesthetizing of the RH led to euphoric-maniacal reactions. Milner (1974), using the same technique, reported no such effects.

Unilateral electroconvulsive shock treatment

Unilateral application of electroconvulsive shock treatment (ECT) has led to some relevant observations. Galin (1974) suggested that RH ECT is more therapeutic than bilateral ECT and that it also minimizes the memory disturbances typically following bilateral treatment.

Deglin (1976) observed that patients receiving RH unilateral ECT (presumably in some way de-activating this hemisphere) became more talkative and articulate yet their intonation was notably less expressive. In addition, these patients had impaired abilities to perceive tone of voice, to sing or recognize popular tunes, to detect missing parts of a picture, and to recognize familiar places. Generally, their mood became easygoing and cheerful.

In contrast, patients receiving LH unilateral ECT tended to become morose and pessimistic in outlook. They frequently complained about

feeling ill. Verbal expression was greatly diminished and they tended to be inattentive to all but very loud speech. The patients' vocabulary was stilted and they had difficulty in naming objects, although their function could be identified. Their recognition and expression of intonation was enhanced, as was their perception of nonverbal, natural sounds. They were able to recognize familiar settings but unable to describe them.

Emotional predispositions

Deglin's (1976) study confirmed perceptual specializations found in other studies. It also suggested the LH as tending towards a positive optimistic outlook and the RH as having a predisposition towards negative emotions. This was confirmed by Natale, Gur, and Gur (1983) who noted a LH tendency towards optimistic or positive judgements.

Tucker (1981) further suggested that although the RH may be specialized for initial emotional arousal, it is the LH which monitors, modifies, and inhibits the response of the RH. Tucker stated that "the two hemispheres seem to exist in some sort of reciprocally balancing, dialectical relationship, each hemisphere's affective tendency opposing and complementing that of the other" (p. 21).

In a related development, one researcher has claimed to be able to control emotional states by altering the rhythm and amplitude of hemispheric switching. Denis Gorges (cited by Hartmann, 1984) developed a device (i.e., the Synchro-Energizer) which is designed to induce different patterns of hemispheric activity. He claimed that designating the induction of various "frequency switching sequences" can be useful in

the treatment of a variety of conditions, including pain, learning disabilities, insomnia, and anxiety.

Unconscious processes

The role of the LH in inhibition of emotion has been integrated into the theory of at least one psychotherapeutic technique--Primal Therapy (Janov & Holden, 1975). Janov wrote of the "minor" hemisphere (RH) as the "feeling" one and related the timelessness often experienced in a primal experience to the nontemporal nature of this hemisphere. Of the LH he stated that "our neurotic acts seem rational to us because the major side helps make them so. That is its function in neurosis" (p.13).

Janov and Holden (1975) also made a convincing argument that neurosis is a condition analogous to being a split-brain patient, where a split between awareness and behavior is evident "when a person acts on a feeling . . . without any idea what impels him to do so" (p. 13). Janov went on to speculate that, concerning the relationship of laterality and mental health, "a normally integrated person would have a balanced hemispheric relationship" (pp. 16-17).

Other researchers have been concerned with the relationship of laterality to the nature of the Unconscious. Commenting upon commissurotomy research, Popper and Eccles (1981) proposed that "the outstanding discovery in the investigations of these subjects is the uniqueness and exclusiveness of the dominant hemisphere in respect to conscious experience" (p. 315). According to the theory of Popper and Eccles, the LH is the mediator of all conscious behavior, while the RH processes unconscious activity. Access to unconscious experience is

therefore dependent upon the "fluid access" between hemispheres, as proposed by Janov and Holden (1975, p. 13).

Split-brain patients provide rather dramatic evidence of this hypothesis. When the image of an object (such as a pencil) was projected to the RH (or presented to the left hand outside of the field of vision), the subjects would insist, when questioned, that they did not see anything (or that they did not know what was in their hand) (Gazzaniga, 1970). The object could, however, be selected nonverbally from among other objects. This research has interesting implications for the concepts of repression and denial. It also suggests that nonverbal techniques may enhance access to repressed or unconscious experience. Some therapies (e.g., Gestalt Therapy, Primal Therapy) seem to make extensive use of techniques related to this possibility.

Evidence summarized by St. James-Roberts (1981) raises some questions regarding the theory of Popper and Eccles. Study of six patients who underwent the removal of the LH (i.e., hemidecortication) clearly demonstrated the retention of comprehension and conscious experience. Some of these patients were even capable of limited propositional expression (Zangwill, 1976).

In support of the function of the LH in psychological defense mechanisms, Blakeslee (1980) related the consequences of RH hemidecortication to the mechanism of rationalization and denial. He found that "after a lifetime of rationalizing the right brain's contributions as its own, the left brain now goes to extreme lengths to keep together the single-mind model" (pp. 17-18). For example, such

patients, when asked to explain their inability to move their left hand, would deny that it was their hand at all.

Relationship to psychopathology

There is mounting evidence that serious psychopathology is related to atypical patterns of laterality. For a more complete discussion of the relationship of laterality to schizophrenia, the reader is referred to Newlin, Carpenter, and Golden (1981). They have catalogued a great variety of hemispheric asymmetries associated with schizophrenia in terms of motor, sensory, electrophysiological, and neuropsychological factors.

LH overactivation. An example of this research is provided by Serafetinides (1972, 1973) who found that high voltage EEG readings over the LH (indicating reduced arousal) were associated with the remission of schizophrenic symptoms. Gur (1977, 1978) conducted research which also suggested that the LH of the schizophrenic is overactivated. His research also indicated that such overarousal led to impaired and inappropriate processing strategies by the LH.

Role of the corpus callosum. Paul Bakan (1976) proposed yet another point of view. Citing evidence for the relationship between dreaming and the RH, he hypothesized that schizophrenic symptomology may derive from the faulty operation of the corpus callosum, and "as a result, dreamlike reality spills over into his waking life, where it influences his actions. The often bizarre behavior of the schizophrenic may be a dream come alive" (p. 68). Bakan (1976) also cited research which involved the

microscopic examination of schizophrenic and normal brains--revealing an abnormal thickening of the corpus callosum among schizophrenics.

Relationship to hypnosis

Hypnosis has been used for many years as an aid to behavioral change. Frumkin, Ripley, and Cox (1978) have demonstrated that there is a shift towards RH cognition under hypnosis. This shift was cited as one way to explain a number of well-known hypnotic effects (e.g., facilitating emotional states, enhancing memory, certain elements of hypnotic suggestion). Similarly, Janov and Holden (1975) speculated that the hypnotist essentially performs a "non-surgical commissurotomy so that one side of the brain does not know what the other side is doing" (p. 13).

Other Personality Factors

Another segment of the literature deals with an even wider variety of personality variables. Wonder and Donovan (1984) presented a number of such relationships which are summarized in Table 6.

Table 6

Suggested Characteristics of Hemispheric Preferences

Persons preferring LH	Persons preferring RH
Organized in their approach	Tend to be spontaneous
Neat and orderly	May appear to be chaotic
Competitive	Noncompetitive
Self-disciplined	Impulsive
Talkative	Self-absorbed
Conscious of time	Oblivious to time
Plan and structure	Let things happen
Prefer written directions	Prefer verbal directions
In control of emotions	Expressive of emotions
Skeptical, demanding of proof	Trusting of self and others
Autocratic and directive	Participative, laissez faire

LEM studies

Some of the research basis for such relationships has been derived from the study of lateral eye movements (LEMs). The monitoring of LEMs has been utilized as a method of determining hemispheric laterality in normal persons (Gur & Gur, 1975; Schwartz, Davidson, & Maer, 1975). According to Ehrlichman and Weinberger (1978), "LEMs are now treated almost exclusively as indicators of differential hemispheric activation. It is presumed that a person's tendency to look to the right or left indicates the relative importance of the [contralateral] left or right hemisphere in the person's functioning" (p. 1092). A number of

researchers have suggested that a third category of "bidirectionals" should be included for those persons who do not consistently fit into the right or left mover classifications (Gur & Gur, 1974; Gur, Gur, & Marshalek, 1975; Schroeder, Eliot, Greenfield, & Soeken, 1976).

Day (1964, 1967) first proposed that LEMs were related to characteristic anxiety reactions--left movers tended to be more inwardly anxious and tense, whereas right movers were more expressive of their anxiety. Bakan (1969) reported that Left movers (i.e., RH dominant) were more susceptible to hypnotic induction than right movers. This has been supported consistently only for males (Bakan & Svorad, 1979; Gur & Gur, 1974). Right movers scored higher on Quantitative than Verbal SAT scores and preferred "hard" (i.e., scientific) majors over "soft" (e.g., arts, humanities) ones. A weak relationship between right movers and a scientific or practical interest has been reported by other researchers (Barnat, 1974; Welten & Etaugh, 1973).

There is other evidence to support Day's (1964, 1967) original observations. Using the Byrne Repression-Sensitization Scale and the Singer-Antrobus Imaginal Processes Inventory, Meskin and Singer (1974) reported left movers to be more "inner attentive." Gur and Gur (1975) found that left movers reported more psychosomatic symptomology (e.g., repression; denial, reaction formation); right movers tended to report more aggressive reactions in the face of frustration and to project negative qualities outwardly. Though unconvinced of the relationship between LEMs and laterality, Ehrlichman and Weinberger (1978) observed that "Left movers do appear more involved with feelings and inner

experience, and right movers appear more concerned with external events and activity" (p. 1094).

James Otteson (1980) studied the relationship of LEMs to several standardized measures. Separate analyses were conducted by sex. For women, significant relationships were found between left movers and greater dogmatism, less concern for external expectations, and greater introversion. Results for males were largely insignificant. Parrott (1984) explored the relationship between LEMs and results from the Adjective Checklist. He found a number of significant relationships between personality variables and LEMs. In samples of psychology and engineering students, Parrott (1984) concluded that bidirectional movers "present the most balanced personality style in terms of personal adjustment, cognitive flexibility and productivity" (p. 871).

A number of other studies have not found consistent differences between left and right movers (Barnat, 1974; Erlichman, 1972; Etauh, 1972; Etauh & Rose, 1973; Wolf-Dorlester, 1976). Thus, the evidence is mixed concerning the relationships of LEMs to a broad range of personality factors.

Field-Independence

Some research has been done relating the concepts of field-independence/dependence to laterality. Witkin, Goudenough, and Oltman (1979) proposed a theory of psychological differentiation based upon these concepts. According to this theory, field-independent persons have the ability to utilize hemispheric processing strengths in flexible relationship to task requirements. In contrast, field-dependent persons

are limited in this respect and respond less appropriately to task requirements.

Silverman, Adevai, and McGough (1966) originally associated sinistrals with greater field-dependence. Utilizing a larger sample (n=96), Newland (1984) reported the opposite results (i.e., that sinistrals tended to be more field-independent than dextrals). The meaning of such conflicting evidence is unclear at this time.

Social perception

Barchas, Harris, Jose, and Rosa (1984) speculated upon the relationship of hemispheric functioning to social interaction. They believed that the two hemispheres process social information in "different but complementary ways" (p. 146). Their theory suggested that the RH would handle the perception of the social structure and the LH would regulate appropriate behavior accordingly.

Kinsbourne (1981) has applied laterality to the well-established constructs of approach and withdrawal behavior. Approach behavior was hypothesized to be mediated by the LH; withdrawal by the RH. It has also been reported that the directing of attention towards the left or the right (thus increasing the activation of the contralateral hemisphere) has an effect upon social influence factors ("Power of beliefs," 1984). It was found that directing attention towards the right was correlated with (a) an increased sense of optimism, (b) relatively greater resistance to persuasion, and (c) a less favorable first impression of others.

Convergent/divergent thinking

Hampton-Turner (1981, p. 106) related personality characteristics to "convergent" and "divergent" styles of thinking. Table 7 presents a summary of the characteristics related to these styles.

Table 7

Characteristics Associated with Different Styles of Thinking

Convergent (LH)	Divergent (RH)
more deferential	more rebellious
less trusting of feelings	more trusting of feelings
traditional thinker	independent thinker
lower self-esteem	higher self-esteem
mannered and controlled	spontaneous and expressive

Overall Summary

In an attempt to summarize the laterality research relevant to educators, Martin Kane (1984, pp. 528-532) has developed a series of tables. To this same end, excerpts are presented in Tables 8-12.

At this point in time, there is as much speculation as fact when it comes to the relationship of laterality to a comprehensive range of personality characteristics. Hopefully, this study may, to some degree, point towards a clearer understanding in this field.

Table 8

Characteristics of Laterality: Speech/Auditory/Language

Left hemisphere	Right hemisphere
right ear	left ear
verbal	nonverbal
grammatic logic	symbolic aspects
verbal memory	tonal memory
phonetics	singing
	musical hearing
	melody
word parts	holistic/Gestalten
spoken words	emotional aspects
	gesturing of hands
	motor aspects

Note. Adapted from "Cognitive styles of thinking and learning" by M. Kane, 1984, Academic Therapy, 19, p. 528-532.

Table 9

Characteristics of Laterality: Visual

Left hemisphere	Right hemisphere
right visual field	left visual field
right eye movers	left eye movers
labels space	spatial organization
	depth perception
parts of space	holistic/Gestalten

Note. Adapted from "Cognitive styles of thinking and learning" by M. Kane, 1984, Academic Therapy, 19, p. 528-532.

Table 10

Characteristics of Laterality: Motor

Left hemisphere	Right hemisphere
right side of body	left side of body
	spatial movement
right tactual	left tactual
	drawing
describing movement	creative movement

Note. Adapted from "Cognitive styles of thinking and learning" by M. Kane, 1984, Academic Therapy, 19, p. 528-532.

Table 11

Characteristics of Laterality: Cognitive

Left hemisphere	Right hemisphere
deductive	inductive
convergent	divergent
focal	diffuse
logical	intuitive
analytic	creative
verbal	visuospatial
abstract	concrete
rational thought	emotional thought
sequencing of concepts	relational concepts

Note. Adapted from "Cognitive styles of thinking and learning" by M. Kane, 1984, Academic Therapy, 19, p. 528-532.

Table 12

Characteristics of Laterality: Affective

Left hemisphere	Right hemisphere
intellectual	emotional
body concept	body image
remembering names	recognition of faces

Note. Adapted from "Cognitive styles of thinking and learning" by M. Kane, 1984, Academic Therapy, 19, p. 528-532.

CHAPTER III

RESEARCH METHODOLOGY

This chapter will consider the elements of the study concerned with methodology. A discussion of the design will be followed by the hypotheses to be tested, sampling considerations, and the procedures employed by the researcher. The chapter will conclude with sections describing the measurement instruments, the data analysis, statistical assumptions and considerations, and the limitations and scope of the study.

Design

Co-relational Studies

According to Isaac and Michael (1974), the purpose of a correlational study is "to investigate the extent to which variations in one factor correspond with variations in one or more other factors based on correlation coefficients" (p. 14). Tuckman (1978) terms this a "co-relational" study and stated that it "involves the collection of two or more sets of data from a group of subjects with the attempt to determine the subsequent relationship between those sets of data" (p. 148). Tuckman went on to say that "co-relational studies serve a useful purpose in determining the relationship among measures and suggesting possible bases of causality" (p. 149).

In this study, correlations were examined between two measures of brain laterality preference (i.e., Your Style of Learning and Thinking [SOLAT] and the Brain Preference Indicator [BPI]) and a wide variety of personality factors derived from the Sixteen Personality Factor Questionnaire (16PF). The use of a co-relational design was appropriate to the purpose of this study and was justified by the exploratory nature of the research. The study involved the examination of 29 key personality factors in relationship to brain laterality. The breadth of this kind of research compensated for a lack of strict experimental control.

Psychometric measurement of brain laterality preference in terms of a comprehensive personality device was designed to help clarify the relationships between these factors and to help identify fruitful areas for further research. Such follow-up research could be focused upon areas where relationships are indicated and could employ more elements of experimental control to enhance internal and external validity. Such an effort, however, is difficult to justify until a clear basis for it exists. Hopefully the present study provides such a basis.

Influences on Validity

Because of the nature of a co-relational study, experimental control was not as stringent as it would be for a true experimental design. This weakened the internal and external validity of the results (Campbell & Stanley, 1963). Nonetheless, some measures were taken to minimize these effects.

The influence of intervening events upon test response was minimal since the testing was performed within a short period of time during two consecutive class periods. Standardized instructions and procedures were also utilized. Also because of the limited period of testing, maturation effects were not a factor as they might have been with other designs.

Since the assessment involved the administration of three different instruments, testing effects were taken into consideration. To partially compensate for the effects of one test upon subsequent responses on other tests, the tests were administered in random order. Because the instruments are objective, pencil-and-paper assessments, instrumentation threats were not a problem as they would have been with a study requiring ratings by observers, for example.

It should be noted, however, that the use of such instruments did involve inferential measurement and other factors such as reading level, response bias, motivational distortion, error of measurement, and so forth. To compensate somewhat for such factors, reading level requirements were limited to the eighth grade level and subjects were assured of the confidentiality of their responses.

Every effort was made to minimize the loss of respondents between sessions, thus decreasing the influence of sampling mortality. Reactive arrangements were a factor since subjects were aware that they were participating in the study. The familiarity of the task requirements (i.e., multiple choice exams) and administration in the classroom environment should have suppressed the influence of such

knowledge. Also, the assurance of confidentiality should have helped to secure candid responses.

The sample was delimited to a specific population and this, of course, affects the generalization of the results. A random cluster selection procedure was used to help insure pre-study equivalence and a normal distribution of characteristics.

Hypotheses

Listed below are the four null hypotheses tested in this study. They represent a logical extension of the research questions proposed in Chapter I. Note that the personality factors designated by a "*" are second-order or composite rather than primary scores.

These factors were derived from the 16PF in order to place the results within the context of a comprehensive measure of personality. They were categorized within the following hypotheses as a heuristic device to relate the instrumentation to the primary areas which were under investigation. Descriptors of primary factors are from Interpreting 16PF Profile Patterns (Krug, 1981).

Hypothesis One

There is no significant correlation between brain laterality preference and any of the following personality factors concerned with creative functioning:

Factor	Descriptor
I.1	Imagination

1.2 Intelligence

1.3 Creativity *

Hypothesis Two

There is no significant correlation between brain laterality preference and any of the following factors concerned with occupational interests:

Factor	Descriptor
2.1	Mechanical-Operative (Realistic) *
2.2	Analytic-Scientific (Investigative) *
2.3	Creative-Self-Expressive (Artistic) *
2.4	Nurturing-Altruistic (Social) *
2.5	Venturous-Influential (Enterprising) *
2.6	Procedural-Systematic (Conventional) *

Hypothesis Three

There is no significant correlation between brain laterality preference and any of the following personality factors concerned with affective variables:

Factor	Descriptor
3.1	Emotional Stability
3.2	Impulsivity
3.3	Suspiciousness
3.4	Insecurity
3.5	Tension

3.6 Sensitivity

3.7 Anxiety *

3.8 Neurosis *

3.9 Tough Poise *

Hypothesis Four

There is no significant correlation between brain laterality preference and any of the following other personality factors:

Factor	Descriptor
4.1	Warmth
4.2	Dominance
4.3	Conformity
4.4	Boldness
4.5	Shrewdness
4.6	Radicalism
4.7	Self-Sufficiency
4.8	Self-Discipline
4.9	Extraversion *
4.10	Independence *
4.11	Leadership *

Sampling

The sample for this study was composed of 205 lower division undergraduate students enrolled at Florida Junior College at Jacksonville (FJC). The sample was limited to right-handed persons

in Associate of Arts (A.A.) or Associate of Science (A.S.) degree programs. This limitation was based upon literature indicating that handedness is a confounding influence and due to the limited representation of sinistrals (perhaps only 10 %) in the general population. Subjects were selected from the student record database by utilizing a random cluster selection procedure based upon class section numbers. The sample was drawn from a population with the demographic characteristics described in Table 13 (1983-84 figures supplied by FJC's Office of Institutional Research).

Sample subjects were 28% male and 72% female. This group consisted of 80% Associate of Arts students and 20% Associate of Science students. Freshmen comprised 55% of the sample; sophomores, 45%. The majority of the subjects (85%) were Caucasian, with 12% Black and 3% not falling into either category. The average age of the males was 21.8 years; 24.7 years for the females. The sample was a relatively normal one, with most scores falling in the average range and a normal distribution evident from an examination of frequency histograms.

It should be noted that this study was "primarily concerned with relationships within the groups studied rather than with the opinions or attitudes of the larger group from which the sample is drawn" (Lewin, 1979, p. 181). Lewin justified the use of a "convenience" sample in such cases instead of the more traditional representative sample. The primary purpose for utilizing random cluster selection was to help insure pre-study equivalence and a normal distribution of characteristics.

The employment of a general sample of undergraduate college students provides a baseline (which does not currently exist) for other

studies involving special subpopulations. The availability of such a baseline should allow more meaningful comparisons and generalizations to be formulated for these subpopulations.

Table 13

1983-84 Student Characteristics for Florida Junior College

Factor		FJC %
Sex		
	Male	41
	Female	59
Race		
	White	79
	Black	18
	Hispanic	1
	American Indian	<1
	Asian	2
Average Age		28

Procedure

The researcher contacted the campus deans, briefed them as to the nature and requirements of the study, and obtained their permission to work with affected instructors. Instructors of selected sections were briefed and asked for their permission to conduct the required assessment during class time. A testing schedule was established in conjunction with consenting instructors.

The students were initially told only that they would be participating in "a study which is attempting to correlate different kinds of personal preferences", that their responses would be held in strictest confidence, and that they would be debriefed when the testing was concluded. Participation was encouraged but optional.

The instructions for each of the three instruments were presented in a standardized manner by the researcher and students were limited to asking questions regarding the technical aspects of these instructions. The instruments were distributed by the researcher and completed in random order by the students. Approximately two sessions were required for completion. Upon completion of all instruments, students were debriefed concerning the details of the study and instructed as to how they could gain access to the results of the study.

Instrumentation

The following instruments were utilized in this study:

1. Your Style of Learning and Thinking (SOLAT), Adult Form C
2. The Brain Preference Indicator (BPI)
3. The Sixteen Personality Factor Questionnaire (16PF), Form D

The SOLAT and the BPI were selected for use because of their brevity, relationship to research findings, adult orientation, ease of use, and availability. Although the use of psychometric measures of laterality preference is still somewhat experimental, these instruments

represented the best such tools currently available. Both instruments were used to help compensate for the relative lack of development in this area and to provide for confirming relationships.

The 16PF was selected because of its comprehensive coverage of personality factors which could be related to counseling interests, its well-established reliability and validity, and the availability of computer scoring services. Form D was selected because of its relative brevity, readability, and the ready availability of booklets for use by the researcher.

Your Style of Learning and Thinking (SOLAT)

Development

The SOLAT was developed by E. Paul Torrance and his associates at the University of Georgia. It is a measure of brain laterality preference based upon extensive research which has mapped the functional specializations of the left and right cerebral hemispheres.

Forms

There are four different forms for adults (A, B, C, and M) (Schwartz & DiMattei, 1981; Torrance & Reynolds, 1980; Torrance, Reynolds, Riegal, & Ball, 1977) and three forms for children and adolescents (A, B, C) (Reynolds, Kaltsounis, & Torrance, 1979). All forms are of a self-report, multiple choice format and have 40 items with three response options per item (except for Form A which has 36 items). For each item, one option represents a RH specialized function, another

the LH function, and the third an integrated way of functioning. These are distributed in random order throughout the tests.

Administration

Administration is untimed with an estimated completion time of 10-15 minutes. Handscoring consists of adding the number of options selected for each of the three option categories, thus resulting in raw scores for Right, Left, and Integrated.

Norms

College/Adult norms are available for the form used in this study (Form C), based upon a norm group of 639 persons from the University of Georgia; University of Nebraska at Lincoln; University of Nebraska at Omaha; Metropolitan State University (St. Paul); North Hennepin Community College (Minneapolis); Florida International University (Miami); 3-M Center (St. Paul), and various in-service education and other community organization groups. Norms for Form C are also available for:

1. College of Education students (N=278)
2. College of Business students (N=129)
3. Finnish college students (N=200)
4. Teachers of gifted students (N=32)
5. Internal Auditors (N=143)
6. Employees of the Safety and Security Inventive Industrial Corporation (N=33)

7. Participants in the Creative Problem Solving Institute (N=36)

8. High school girls (N=185)

The SOLAT has not yet been commercially distributed but has been openly published in various journals. Torrance and Reynolds (1980) specifically permit copies of Form C to be used for purposes of research.

Reliability

Four studies of alternate form reliability have been conducted, resulting in reliability coefficients ranging from .63 to .84. Torrance and Reynolds (1980) stated that "on the basis of these data, the alternate form reliabilities seem to be satisfactory. Since new areas of behavior were sampled, it is not surprising that the coefficients of correlation were not higher" (p. 2).

A pilot (n=50, two week separation) test-retest study conducted by the researcher at Florida Junior College resulted in a reliability coefficient of 0.78. The technical manual also presents item analysis data (Torrance & Reynolds, 1980, p. 17) for Form C.

Validity

To establish validity, the SOLAT was correlated with 17 measures of creativity (assumed to be a RH specialization; N=33). As would be predicted, consistent and significant positive correlations were found in relationship to the Right hemisphere score; consistent and significant negative correlations were found in relationship to the Left hemisphere score. In another study, 36 participants in a creative problem-solving seminar were found to score significantly higher on the Right hemisphere

scale when compared to a general norm group of 324 adults. This finding is cited as indirect support for validity.

Correlations in support of validity are also presented in relationship to Weather types (Virtaneva, 1978), Transactional Analysis types (Berne, 1964), and Sheldon's (1942) somatotypes. Correlation coefficients were relatively low, yet a number were significant. The Right hemispheric scale was positively correlated to the Warm Weather Type, Sheldon's Somatotonia body type, and the Transactional Analysis Child Self; it was negatively correlated to Sheldon's Cerebretonia body type. The Left hemisphere scale was positively correlated to the Cerebretonia body type and negatively correlated to the Viscerotonia and Somatotonia types. All of these correlations were in directions predicted by laterality theory. The reader is referred to the Norms-Technical Manual (Torrance & Reynolds, 1980) for descriptions of these various scales. The Manual lists over 30 studies which have utilized the SOLAT.

Brain Preference Indicator (BPI)

Development

The BPI is an experimental instrument developed by Wonder and Donovan (1984) and published in their book, Whole Brain-Thinking. Like the SOLAT, it is a measure of brain laterality preference based upon research exploring laterality specializations and effects.

Forms

There is only one form, which is of a self-report, multiple choice format. The version in the book has 36 items; upon request, the authors supplied the researcher with a later version consisting of 30 items. Each response option has been assigned a weight on a scale from one to nine. A weight of one indicates a strong LH bias; a score of nine, a strong RH bias. Options with various weights are arranged in random order for all items.

Administration

Administration is untimed with an estimated completion time of 10-15 minutes. Handscoring consists of summing the weights of the options selected and dividing by the number of options marked. If all the items are completed, the result is an average item weight ranging from 1.3 to 8.5 or a total score from 38 to 255.

Norms

The authors reported that the instrument has been administered to over 500 individuals who have attended their seminars but a published description of this group was not available.

Reliability and Validity

No formal reliability data are reported. The researcher conducted a pilot test-retest (n=50, two week separation) study at Florida Junior College which resulted in a reliability coefficient of 0.85. Validity of the item weighting was derived from a comparison of item responses with

the results of an EEG dominance test at the Biofeedback Institute of Denver. No technical data is available concerning the number of persons thus tested or the significance of the relationships.

In Whole-Brain Thinking, the authors did present the research rationale for each question, explaining the relationship of the options to laterality findings (Wonder & Donovan, 1984, pp. 41-47). Although it appears to be promising, the BPI is considered experimental in nature and lacks the formal validation one might otherwise expect. Because of this, it was used as an adjunct to the better established SOLAT.

Sixteen Personality Factor Questionnaire (16PF)

Development

The 16PF was first published by Raymond Cattell and The Institute for Personality and Ability Testing in 1949. Since that time, it has been established as one of the most useful and best validated instruments available to assess personality. It is a comprehensive measure of normal dimensions of personality, including sixteen primary factors, at least eight secondary factors, and numerous other statistically derived scales. The terminology used for these factors within this study was adopted from Interpreting 16PF Profile Patterns (Krug, 1981). Most of the following technical information was based upon data found within The Handbook for the 16PF (Cattell, Eber, & Tatsuoka, 1970).

Forms

There are currently five published forms of the 16PF (A, B, C, D, E). Forms A and B each have 187 items and a reading level of 7th-8th

grade range. Forms C and D are somewhat shorter (105 items each) and have a lower reading level. Form E has 128 items and is intended for use with low-literate groups with limited reading ability. A parallel form to Form E (i.e., Form F) was under development at the time of the last revision of the manual (1970). All forms employ a self-report, multiple choice format. Forms A, B, C, and D have three response options for each item; Form E has two. Forms A and B have 10-13 items for each primary scale; Forms C and D have six to seven. Questions are arranged in a factor-rotation order.

Administration

Administration is untimed but estimated at 50 minutes for Forms A and B and 30-40 minutes for all other forms. Handscoring and machine scoring (with computerized profile or narrative interpretation) are available. Scale scores (stens), ranging from one to ten, are derived by applying appropriate norms. The average range for sten scores is between 4.5 and 6.5.

Norms

A variety of well-established norm groups are provided, including: general adult population, college students, and high school students. Each of these groups is subdivided into male, female, and combined sex tables. For the purpose of this study, the sex-appropriate college student norms were used.

Reliability

Test-retest reliabilities (4-7 day interval) for the 16PF range from .54 to .93 for American subjects, with most coefficients in the 0.7 to 0.8 range (Cattell, Eber, & Tatsuoka, 1970). Stability coefficients derived from retest after a two month interval are within the same range.

Validity

Evidence is presented in the 16PF handbook for the validity of pure factors in relationship to the entire battery, with coefficient correlations "at least as high as have been reached for any attempted primary factor-pure measures" (Cattell, Eber, & Tatsuoka, 1970, p. 37). Construct validity coefficients ranging consistently above .90 are also reported in the Handbook. Correlations with other established personality measures (i.e., The Guilford-Zimmerman Temperament Survey and the Minnesota Multiphasic Personality Inventory) are presented as an additional source of validity. Predictive validity has been established in hundreds of research studies relating the 16PF scales to numerous criteria. The reader is referred to the Handbook for a representative listing of such studies.

Forms A and B include three response validity scales: faking good, faking bad and random. Forms C and D have one motivational distortion scale. Krug (1978) developed a method for adjusting scores based upon these scales. This correction is provided for answer sheets profiled by the computer scoring service and was utilized in this study.

Data Analysis

Scores from the SOLAT and the BPI were coded onto the 16PF answer sheet. These answer sheets were transmitted to the Institute for Personality and Ability Testing for scoring. The results were returned in the form of a computer tape which was analyzed utilizing the Statistical Package for the Social Sciences (SPSS). A two-tailed confidence interval of 95% was used to establish significance. Results significant at the .01 and .001 level are also noted and exact probabilities are utilized in some tables. The type of analyses utilized is described below; the specific statistical techniques employed are presented in Tables 14-16. The analyses to be were ordered in accordance with the recommendations found in Exploratory Data Analysis (Hartwig & Dearing, 1979).

Univariate analysis techniques were used to examine the statistical characteristics of each individual variable. An examination of the frequency histograms and the application of the Kolmogorov-Smirnov goodness of fit test (in the case of the laterality scores) were used to establish the normality of the factors.

Bivariate analysis techniques were used to conduct an examination of the relationships between pairs of variables in accordance with the heuristic categories established by the null hypotheses. Sex was included as a factor to be analyzed because of the separate sex norms used by the 16PF and for the purpose of determining the need for separate representation of male and female results. As a result of this analysis, it was determined that separate sex presentation was most appropriate. A

series of scatter plots were also examined to determine the linearity of the relationships.

Finally, a type of multivariate analysis was used to confirm the significance of the relationship of laterality to the personality factors. This analysis focused soley upon the primary factors of the 16PF, with the demographic variable of age included.

The selection of the statistical procedures specified below was based upon the level of measurement inherent in the variables (i.e., interval) and the purpose of the study (i.e., the investigation of correlations). An outline of the data analysis is presented in Tables 14-16.

Table 14

Outline of Univariate Analyses

Statistics
Frequency histogram
Mean
Standard deviation
Applied to
Sex, Age
SOLAT and BPI scores
Hypothesis One (H1) factors
Hypothesis Two (H2) factors
Hypothesis Three (H3) factors
Hypothesis Four (H4) factors

Table 15

Outline of Bivariate Analysis

Statistics	
Pair-wise Correlational Analysis	
t-test for sex differences	
Pearson product-moment	
Scatter plot	
Applied to	
Sex	x SOLAT
	x BPI
H1 factors	x SOLAT
	x BPI
H2 factors	x SOLAT
	x BPI
H3 factors	x SOLAT
	x BPI
H4 factors	x SOLAT
	x BPI

Table 16

Outline of Multivariate Analysis

Statistics	
Multiple Regression (backward stepwise elimination)	
Applied to	
16PF primary factors (plus age, by sex)	x SOLAT
	x BPI

Statistical Assumptions and Considerations

Assumptions of Correlation/Regression

Lewis-Beck (1980, p.26) identified the assumptions underlying the statistical techniques of correlation and regression. Basically, these involve:

1. no specification error
2. no measurement error
3. assumptions concerning the error term, homoskedasticity, lack of autocorrelation, and normality

The first assumption concerns the linearity of the relationships involved. It also addresses the exclusion of irrelevant factors, the inclusion of relevant factors into the regression equation, and the lack of multicollinearity. The second assumption is obvious--the measurement of the factors must be accurate if any of the calculations based upon

these measures are to be meaningful. The third assumption involves the expectation of zero value error terms with (a) a constant variance for all values of the factors involved (i.e., homoskedasticity), (b) a lack of correlation with each other, and (c) a normal distribution. The use of the specific techniques employed within this study also require an interval level of measurement.

Though few studies can claim to adhere perfectly to these assumptions, a serious violation of one or more of them can call into question the propriety of parametric correlational and regression techniques. Concerning regression in particular, however, Kerlinger and Pedhazar (1973) indicated that it is a "robust" technique that is not easily influenced by variance from such assumptions.

The assumption of normality was verified by inspection of the frequency histograms produced for each of the variables within the study. The normality of personality variables has long been established and was evident from the inspection described above. Because of a lack of data concerning the distribution of laterality, the additional step was taken of conducting a Kolmogorov-Smirnov goodness of fit test on the laterality scores. The results indicated an acceptably normal distribution for both the BPI and SOLAT (refer to Table 17).

The assumption of linearity was affirmed through the use of scatter plots produced for each of the pairwise comparisons. These plots appeared to indicate linear relationships among the variables. Multicollinearity was investigated by analyzing the correlation matrix. It did not appear to be a problem with any but the composite factors (as one might expect since they were derived from some of the same primary

factors). This finding supported the decision to only utilize primary factors in the regression analysis.

Statistical Significance

Because the null hypotheses did not indicate any expected valence of association, a two-tailed confidence interval of 95% was utilized for the bivariate analyses, with .01, .001, and exact probabilities indicated as appropriate. The criterion for inclusion/elimination in the multiple regression was a .10 level of significance. The Pearson product moment correlations were based upon data after the pairwise deletion of missing values; regression equations were based upon data left after listwise deletion of such values. Determination of the significance of the bivariate correlations was based upon the calculation of Student's *t*. The variance ratio (F) statistic was used to determine significance related to the multiple regression equations.

Score Characteristics

Calculations were based upon the raw scores of the BPI and the SOLAT; the sten scores of the 16PF. BPI scores had a possible range of 38-255. SOLAT scores could range between 0-40 for each of the three scales. The scores for the counseling-related factors were sten scores (on a scale from 1-10), normed on sex appropriate college norm groups, and corrected for motivational distortion.

Table 17

Kolmogorov-Smirnov Goodness of Fit Results for Normal Distribution

Test	Male		Female		Combined	
	K-S Z	2-Tailed P	K-S Z	2-Tailed P	K-S Z	2-Tailed P
BPI	.65	.79	.75	.64	.71	.69
SOLAT						
Left	.76	.61	.76	.61	.94	.34
Right	.68	.75	.92	.37	.90	.39
Integ.	.72	.68	.83	.49	.89	.40

Limitations and Scope of the Study

The scope and limitations of the study have been discussed in terms of its design and the influences on validity. This study was conducted as an initial exploration of factors which are of concern to the counseling profession. Its primary limitations pertained to the lack of a truly experimental design, the nature of the sample selected, and the use of inferential measurement techniques of relatively limited sophistication. Given these limitations and considerations, the study (hopefully) made a significant contribution in terms of the application of laterality concepts to counseling-related concerns and provides the basis for further study of the topic.

CHAPTER IV

RESULTS OF THE STUDY

This study investigated the relationship of brain laterality preference to personality factors classified in terms of creative functioning, occupational interests, affective variables, and other personality factors. This chapter first presents a description of the distribution characteristics of the laterality measures and the factors categorizied within each hypothesis. Then the correlational results related to each hypothesis and the regression analysis are presented.

Distribution Characteristics

T-tests were utilized to determine if there were significant differences related to sex and any of the other variables in the study (refer to Tables 19-23). This was done to guide the presentation of data (i.e., combined versus separate sex tables). Significant differences were obtained for the seven factors listed in Table 18. These factors were distributed among all four null hypotheses. It is notable that significant sex differences were not found on any of the measures of laterality.

Laterality Distribution

The students were tested with two measures of laterality. Table 19 presents the data related to the distribution of scores on each test. Sample means were very close for the SOLAT Left and Right scales--the mean for the SOLAT Left was 12.5, compared to 12.4 for the SOLAT Right. The mean for the Integrated scale was higher (15.0).

The BPI mean score, when divided by the number of items (as suggested by the test authors), resulted in a score of 4.5. This is exactly midway on the 1-9 scale presented as a continuum from left to right hemispheric preference.

Hypothesis One Factors

Table 20 provides the distribution data for the three factors related to creative functioning. The mean score for the Intelligence factor was 4.8--lower in rank than the means for the other two factors. It is also the only factor in this group that did not exhibit significant differences between males and females (refer to Table 18). As can be seen, females scored higher on both Imagination (female mean = 5.5; male mean = 4.7) and Creativity (female mean = 5.5; male mean = 4.8); and both male means were on the low end of the range for the personality factors under consideration. All means, however, did fall within the average range (i.e., 4.5 - 6.5).

Hypothesis Two Factors

Table 21 provides the distribution data related to the six occupational interest factors. All means were within the average range. Significant differences were found between males and females on the Investigative and the Artistic factors, with the female means being higher on both factors. The highest combined sex means were for the Realistic (mean = 5.6) and Enterprising (mean = 5.4) factors; the lowest for the Social (mean = 4.9) and Investigative (mean = 5.0) factors.

Hypothesis Three Factors

Table 22 provides the distribution data related to the nine affective factors. The Tension factor received the highest mean score (6.2), closely followed by Tough Poise (6.0)--both in the high average range. Suspiciousness (5.9), Anxiety (5.9), and Neurosis (5.9) were only slightly lower and fell in the average range. The lowest mean scores were for Emotional Stability (5.3) and the Sensitivity factor--the latter being the only H3 factor with a significant sex difference.

Hypothesis Four Factors

Table 23 provides the distribution data related to the 11 general personality factors in Hypothesis Four. The highest mean (6.2) was recorded for the Self-Sufficiency factor; the lowest (4.7) for Radicalism--both of the factors where sex made a significant difference. Females scored slightly above the average range on Shrewdness (mean = 6.0) and Self-Sufficiency (mean = 6.3). Males scored

lower than females on both these scales. Males and females scored in the slightly below average and the low average range (respectively) on the Radicalism factor, with the males scoring lower than the females (male mean = 4.2; female mean = 4.9). Scores for all other H4 factors were within the average range.

Table 24 presents a summary of the factor distributions. It is arranged according to the sten scale utilized by the 16PF.

Table 18

Significant Sex Differences in Factors

Factor	Descriptor	Male		Female		2-Tail
		Mean	SD	Mean	SD	Prob.
1.1	Imagination	4.7	1.9	5.5	1.8	.01
1.2	Creativity	4.8	1.6	5.5	1.7	.01
2.2	Investigative	4.6	1.6	5.1	1.7	.04
2.3	Artistic	4.8	1.5	5.5	1.8	.01
3.6	Sensitivity	4.8	1.3	5.4	1.8	.004
4.6	Radicalism	4.2	1.4	4.9	1.7	.003
4.7	Self-Sufficiency	5.8	1.7	6.3	1.9	.05

Table 19

Distribution of Laterality Scores with Sex Difference Probability

Test	Male		Female		Combined		2-Tail
	Mean	SD	Mean	SD	Mean	SD	Prob.
BPI	134.2	24.5	137.2	21.3	136.3	22.3	.43
SOLAT							
Left	12.1	4.6	12.6	4.0	12.5	4.1	.44
Right	11.5	3.6	12.7	5.1	12.4	4.8	.07
Integ.	15.8	4.8	14.6	5.5	15.0	5.3	.15

Table 20

Distribution of Hypothesis One (H1) Factors with Sex Difference Probability

H1 Factors	Male		Female		Combined		2-Tail
	Mean	SD	Mean	SD	Mean	SD	Prob.
1.1 Imagination	4.7	1.9	5.5	1.8	5.2	1.8	.01
1.2 Intelligence	4.6	2.0	4.9	1.8	4.8	1.9	.37
1.3 Creativity	4.8	1.6	5.5	1.7	5.3	1.7	.01

Table 21

Distribution of Hypothesis Two (H2) Factors with Sex Difference Probability

H2 Factors	Male		Female		Combined		2-Tail
	Mean	SD	Mean	SD	Mean	SD	Prob.
2.1 Realistic	5.8	1.5	5.5	1.4	5.6	1.4	.18
2.2 Investigative	4.6	1.6	5.1	1.7	5.0	1.6	.04
2.3 Artistic	4.8	1.5	5.5	1.8	5.3	1.7	.01
2.4 Social	4.7	1.5	4.9	1.8	4.9	1.7	.48
2.5 Enterprising	5.5	1.4	5.3	1.6	5.4	1.6	.28
2.6 Conventional	5.2	1.9	5.3	1.6	5.3	1.7	.76

Table 22

Distribution of Hypothesis Three (H3) Factors with Sex Difference Probability

H3 Factors	Male		Female		Combined		2-Tail
	Mean	SD	Mean	SD	Mean	SD	Prob.
3.1 Emot. Stabil.	5.3	1.7	5.3	1.8	5.3	1.8	.83
3.2 Impulsivity	5.6	1.9	5.4	1.8	5.5	1.9	.45
3.3 Suspiciousness	6.0	2.2	5.9	1.9	5.9	2.0	.64
3.4 Insecurity	5.4	1.8	5.8	2.1	5.7	2.0	.17
3.5 Tension	5.9	1.9	6.3	1.8	6.2	1.8	.24
3.6 Sensitivity	4.8	1.3	5.4	1.8	5.3	1.7	.004
3.7 Anxiety	5.9	1.4	5.9	1.7	5.9	1.6	.86
3.8 Neurosis	5.6	1.5	6.0	1.6	5.9	1.6	.10
3.9 Tough Poise	5.9	1.6	6.0	1.7	6.0	1.7	.75

Table 23

Distribution of Hypothesis Four (H4) Factors with Sex Difference Probability

H4 Factors	Male		Female		Combined		2-Tail
	Mean	SD	Mean	SD	Mean	SD	Prob.
4.1 Warmth	5.3	2.0	5.3	1.9	5.3	1.9	.99
4.2 Dominance	5.8	1.9	5.7	2.1	5.7	2.0	.66
4.3 Conformity	5.7	1.8	5.5	1.7	5.6	1.7	.46
4.4 Boldness	5.5	1.7	5.5	1.8	5.5	1.8	.99
4.5 Shrewdness	5.6	1.6	6.0	1.7	5.9	1.6	.09
4.6 Radicalism	4.2	1.4	4.9	1.7	4.7	1.7	.003
4.7 Self-Suffic.	5.8	1.7	6.3	1.9	6.2	1.9	.05
4.8 Self-Discip.	5.4	1.8	5.5	1.8	5.5	1.8	.64
4.9 Extraversion	5.6	1.5	5.3	1.6	5.3	1.6	.16
4.10 Independence	5.2	1.6	5.4	1.5	5.3	1.5	.48
4.11 Leadership	5.6	1.3	5.3	1.4	5.4	1.4	.12

Table 24

Categorization of Personality Factor Distribution

Slightly below average 4.0 - 4.4	Low average 4.5 - 4.9	Average 5.0 - 5.9	High average 6.0 - 6.5
Radicalism (M)	Imagination (M)	Imagination (F)	Tension
	Creativity (M)	Creativity (F)	Tough Poise
	Investigative (M)	Realistic	Shrewdness (F)
	Artistic (M)	Investigative (F)	Self-Suffic(F)
	Social	Artistic (F)	
	Sensitivity (M)	Enterprising	
	Radicalism (F)	Conventional	
	Intelligence	Emotional Stability	
		Impulsivity	
		Suspiciousness	
		Insecurity	
		Sensitivity (F)	
		Anxiety	
		Neurosis	
		Warmth	
		Dominance	
		Conformity	
		Boldness	
		Shrewdness (M)	
		Self-Sufficiency (M)	
		Self-Discipline	
		Extraversion	
		Independence	
		Leadership	

Note. (M) = male results (F) = female results

Results Related to the Null Hypotheses

The null hypotheses involved the possible correlation between brain laterality preference and certain counseling-related personality factors. As such, they were amenable to analysis utilizing the Pearson product moment correlation technique. The following section discusses

the results of the application of this technique to the data collected in this study. Separate sex tables are presented because of the variation in sample size between males and females (which affected the calculation of significance), the differences found in the distribution of scores due to sex, and the separate sex norming used with the 16PF.

One of the advantages of using two different instruments was the opportunity to determine if the resulting correlations varied in such a way as to confirm each other. A negative correlation on the BPI indicates a move towards the Left end of the continuum of laterality as the specified personality factor increases in value. If the SOLAT Left scale is positively correlated with this same factor, these correlations would confirm each other. A negative correlation on the SOLAT Right scale would also provide a (somewhat weaker) degree of confirmation.

Conversely, a positive correlation on the BPI indicates a move towards the Right end of the laterality continuum as the specified personality factor increases in value. Therefore, a positive correlation on the SOLAT Right scale or a negative correlation on the SOLAT Left scale would confirm such a relationship. Because of the experimental nature of the BPI, correlations related to this instrument should be cautiously interpreted unless confirmed by one or more scales of the SOLAT.

Hypothesis One

This hypothesis was formulated as follows:

There is no significant correlation between brain laterality

preference and any of the following factors concerned with creative functioning:

Factor	Descriptor
1.1	Imagination
1.2	Intelligence
1.3	Creativity

Table 25 presents the correlation matrix related to this hypothesis. Imagination was significantly and positively correlated with SOLAT Left scores ($r = .245$) and negatively correlated with SOLAT Integrated scores ($r = -.309$) for male students. There were no significant correlations on this factor for females.

Intelligence was positively correlated with SOLAT Left scores ($r = .322$) and negatively for SOLAT Right scores ($r = -.354$) for males. For females there was a significant negative correlation between Intelligence and the SOLAT Left scale ($r = -.174$).

There were a number of significant correlations related to Creativity. For males, a negative correlation on the BPI ($r = -.345$) was confirmed with a corresponding positive correlation with the SOLAT Left scale ($r = .297$). For females, there was a negative correlation with the SOLAT Right scale ($r = -.204$) and a positive correlation with the SOLAT Integrated scale ($r = .191$).

Hypothesis Two

This hypothesis was formulated as follows:

There is no significant correlation between brain laterality

preference and any of the following factors concerned with occupational interests:

Factor	Descriptor
2.1	Mechanical-Operative (Realistic)
2.2	Analytic-Scientific (Investigative)
2.3	Creative-Self-Expressive (Artistic)
2.4	Nurturing-Altruistic (Social)
2.5	Venturous-Influential (Enterprising)
2.6	Procedural-Systematic (Conventional)

Table 26 presents the data related to this hypothesis. The Realistic factor was positively correlated at a significant level with the SOLAT Integrated scale for both males ($r = .282$) and females ($r = .219$). In addition, for females, significant negative correlations were found between this factor and the BPI score ($r = -.166$) and the SOLAT Right scale ($r = -.291$). The direction of these last two correlations appeared to confirm each other.

The Investigative factor was negatively related to the SOLAT Right scale for both males ($r = -.381$) and females ($r = -.191$). For males, there was also a conflicting positive correlation with the BPI scores ($r = .341$).

The Artistic factor was negatively correlated with the BPI for males ($r = -.278$) and females ($r = -.148$). For females, there were also significant correlations related to the SOLAT Right ($r = -.221$) and Integrated ($r = .137$) scales.

The Social factor had the weakest pattern of correlation. There were no significant correlations for males on this factor. For females, the

SOLAT Integrated score was the only one significantly related (r = -.173) to this factor.

With regard to the Enterprising factor, for males there was a negative correlation with the SOLAT Left scale (r = -.284) and a positive one with the SOLAT Integrated scale (r =.322). For females, a negative correlation with the BPI was significant (r = -.206).

The Conventional factor was significantly correlated with the SOLAT Right scale (r = -.246) for males. For females, this factor was negatively correlated with the BPI (r = -.147) and positively correlated with the SOLAT Left scale (r = .168)--these scores appearing to confirm each other.

Hypothesis Three

This hypothesis was formulated as follows:

There is no significant correlation between brain laterality preference and any of the following factors concerned with affective variables:

Factor	Descriptor
3.1	Emotional Stability
3.2	Impulsivity
3.3	Suspiciousness
3.4	Insecurity
3.5	Tension
3.6	Sensitivity
3.7	Anxiety

3.8 Neurosis

3.9 Tough Poise

Table 27 summarizes the correlational data related to this hypothesis. A presentation of significant correlations related to this hypothesis will, by necessity, focus upon results for females. Out of a matrix of 36 correlations, only one significant correlation ($r = -.261$, between Insecurity and the SOLAT Integrated scale) was found for males. The following paragraphs, therefore, refer to the female sample.

Emotional Stability was significantly correlated with both the SOLAT Right ($r = -.147$) and Integrated ($r = .180$) scales. Impulsivity was positively correlated with the SOLAT Right scale ($r = .198$). The Suspiciousness factor was positively correlated with the BPI ($r = .166$) and, correspondingly, with the SOLAT Right scale ($r = .153$).

Insecurity was positively correlated ($r = .251$) with the BPI scale and negatively correlated with the SOLAT Integrated scale ($r = -.157$). The Tension factor was positively correlated with the BPI ($r = .291$) and the SOLAT Right scale ($r = .212$); negatively correlated with the SOLAT Integrated scale ($r = -.190$).

The Sensitivity factor was significantly correlated with the SOLAT Left scale ($r = .187$) and with the SOLAT Right scale ($r = -.137$). Anxiety was significantly correlated with three of the four scales: positively correlated with the BPI ($r = .258$) and with the corresponding SOLAT Right scale ($r = .233$); negatively correlated with the SOLAT Integrated scale ($r = -.225$).

The Neurosis factor was positively correlated with the SOLAT Left scale ($r = .201$) and negatively correlated with the SOLAT Integrated

scale (r = -.177). The Tough Poise factor was not significantly correlated with any of the laterality scales.

Hypothesis Four

The hypothesis was formulated as follows:

There is no significant correlation between brain laterality preference and any of the following factors concerned with other personality factors:

Factor	Descriptor
4.1	Warmth
4.2	Dominance
4.3	Conformity
4.4	Boldness
4.5	Shrewdness
4.6	Radicalism
4.7	Self-Sufficiency
4.8	Self-Discipline
4.9	Extraversion
4.10	Independence
4.11	Leadership

Table 28 presents the correlational data related to this hypothesis. The Warmth factor was positively correlated with the BPI (r = .267) and negatively correlated with the SOLAT Left scale (r = -.291) for males. For females, this factor was positively correlated with the SOLAT

Right scale (r = .148) and negatively correlated with the SOLAT Integrated scale (r = -.200).

The Dominance factor had no significant correlations with any of the laterality scales. The Conformity factor had no significant correlations for males. For females, however, three of the four measures of laterality were found to be significantly related to Conformity: a negative correlation with the BPI (r = -.137); and corresponding correlations with the SOLAT Left scale (r = .220) and with the SOLAT Right scale (r = -.190).

The Boldness factor only had one significant correlation--a negative one with the SOLAT Left scale (r = -.285) for males. One significant correlation was also found for Shrewdness--a negative correlation with the SOLAT Integrated scale (r = -1.55) for females. Radicalism was found to be negatively correlated with the SOLAT Left scale (r = -.228) for females; there were no significant correlations on this factor for males.

The Self-Sufficiency factor was negatively correlated with the BPI (r = -.247) for males and positively correlated with the SOLAT Integrated scale (r = .182) for females. Self-Discipline was negatively correlated with the BPI for both males and females. For females, there were corresponding correlations on the SOLAT Left scale (r = .281) and the SOLAT Right scale (r = -.398). The SOLAT Integrated scale was also positively correlated with Self-Discipline (r = .139) for females.

Extraversion was found to be positively correlated with the BPI (r = .254) for males. For females this factor was positively correlated with the SOLAT Right scale (r = .155). The Independence factor

had no significant correlations for males; a negative correlation with the SOLAT Left scale (r = -.182) for females.

The last factor within this hypothesis, Leadership, was positively related to the SOLAT Integrated scale (r = .309) for males. Females had a negative correlation with the BPI (r = -.303) and a related negative correlation with the SOLAT Right scale (r = -.174).

Table 25

Correlation of Laterality with H1 Factors

		SOLAT		
H1 factors	BPI	Left	Right	Integ.
Males				
1.1 Imagination	-.070	.245 *	.122	-.309 **
1.2 Intelligence	-.114	.322 **	-.354 *	.032
1.3 Creativity	-.345 **	.297 *	-.143	-.082
Females				
1.1 Imagination	.015	.057	-.041	-.039
1.2 Intelligence	.102	-.174 *	.109	-.005
1.3 Creativity	.016	-.072	-.204 **	.191 **

* $p < .05$ ** $p < .01$

Table 26

Correlation of Laterality with H2 Factors

H2 factors	BPI	SOLAT		
		Left	Right	Integ.
Males				
2.1 Realistic	-.058	-.164	-.114	.282 *
2.2 Investigative	.341 **	.212	-.381 **	.144
2.3 Artistic	-.278 *	.170	-.137	.015
2.4 Social	.166	-.030	-.029	.041
2.5 Enterprising	.063	-.284 *	-.133	.322 **
2.6 Conventional	-.173	-.023	-.246 *	.199
Females				
2.1 Realistic	-.166 *	.053	-.291 *	.219 *
2.2 Investigative	-.081	.038	-.191 *	.100
2.3 Artistic	-.148 *	.035	-.221 **	.137 *
2.4 Social	-.029	.104	.092	-.173 *
2.5 Enterprising	-.206 **	.003	-.015	-.008
2.6 Conventional	-.147 *	.168 *	-.040	-.121

* $p < .05$ ** $p < .01$

Table 27

Correlation of Laterality with H3 Factors

H3 factors	BPI	SOLAT Left	SOLAT Right	SOLAT Integ.
Males				
3.1 Emot. Stability	.188	-.125	.063	.098
3.2 Impulsivity	.143	.068	-.093	-.018
3.3 Suspiciousness	-.127	.163	-.225	-.003
3.4 Insecurity	-.079	.118	.144	-.261 *
3.5 Tension	.191	.055	.046	-.052
3.6 Sensitivity	.127	.151	.064	.109
3.7 Anxiety	.052	.112	.040	-.141
3.8 Neurosis	-.032	.079	.162	-.182
3.9 Tough Poise	.036	.109	-.016	-.067
Females				
3.1 Emot. Stability	-.065	-.063	-.147 *	.180 *
3.2 Impulsivity	.032	-.120	.198 **	-.065
3.3 Suspiciousness	.166 *	-.025	.153 *	-.106
3.4 Insecurity	.251 **	.069	.121	-.157 *
3.5 Tension	.291 **	.044	.212 **	-.190 **
3.6 Sensitivity	-.125	.187 **	-.137 *	-.032
3.7 Anxiety	.258 **	.051	.233 **	-.225 **
3.8 Neurosis	.124	.201 **	.039	-.177 *
3.9 Tough Poise	-.010	-.037	.030	.009

* $p < .05$ ** $p < .01$

Table 28

Correlation of Laterality with H4 Factors

H4 factors	BPI	SOLAT		
		Left	Right	Integ.
Males				
4.1 Warmth	.267 *	-.291 *	.078	.138
4.2 Dominance	-.020	-.201	.028	.130
4.3 Conformity	-.152	-.101	-.078	.165
4.4 Boldness	.105	-.285 *	.150	.108
4.5 Shrewdness	-.096	.122	-.067	-.001
4.6 Radicalism	-.154	.199	-.154	-.038
4.7 Self-Suffic.	-.247 *	.140	-.153	.018
4.8 Self-Discip.	-.304 **	-.028	-.167	.146
4.9 Extraversion	.254 *	-.226	.065	.109
4.10 Independence	-.154	.065	-.122	.022
4.11 Leadership	-.050	.176	-.198	.309 **

Table 28 (continued)

H4 factors	BPI	SOLAT Left	SOLAT Right	SOLAT Integ.
Females				
4.1 Warmth	-.051	.108	.148 *	-.200 **
4.2 Dominance	-.003	-.131	.005	.073
4.3 Conformity	-.137 *	.220 **	-.190 **	-.003
4.4 Boldness	-.133	.131	-.047	-.083
4.5 Shrewdness	-.009	.060	.106	-.155 *
4.6 Radicalism	.134	-.228 **	.125	.035
4.7 Self-Suffic.	.052	-.104	-.127	.182 *
4.8 Self-Discip.	-.402 **	.281 **	-.398 **	.139 *
4.9 Extraversion	-.043	.036	.155 *	-.154 *
4.10 Independence	.024	-.182 *	-.016	.117
4.11 Leadership	-.303 **	.041	-.174 *	.112

* $p < .05$ ** $p < .01$

Results of Multiple Regression

A type of multivariate analysis was used to further study the data. Specifically, a stepwise backward elimination form of multiple regression was employed. The purpose of this procedure was to seek additional information regarding the relationship between the 16PF primary factors and the laterality measures. Only the 16 primary factors (with sex and age variables) were included because the other factors were derived from

these scores and therefore unduly subject to multicollinearity (which was confirmed by an inspection of the correlation matrix).

The backward elimination method of regression used an elimination criterion of .10 significance--the default setting for this technique, provided within the SPSS program. Separate analyses were conducted for males and females for the same reasons applying to the bivariate analysis. Table 29 presents this data for males; Table 30 for females.

BPI-Related Data

For males, the regression analysis for the BPI resulted in an equation with three significant factors: Age (Beta = -.268), Warmth (Beta = .272), and Self-Discipline (Beta = -.243). This equation had a multiple correlation coefficient of .478, significant at the .01 level. This combination of factors accounted for approximately 23% of the variance between the variables.

For females, the regression resulted in the retention of four significant factors: Age (Beta = -.197), Imagination (Beta = .167), Warmth (Beta = -.154), and Self-Discipline (Beta = -.359). This equation had a multiple correlation coefficient of .458, significant below the .001 level. Approximately 21% of the variance between factors was explained by these four factors.

Three factors were retained in common by males and females: Age, Warmth, and Self-Discipline. The correlations for Warmth, however, were positive for males and negative for females.

SOLAT Left-Related Data

For males, four significant factors were retained: Intelligence (Beta = .339), Insecurity (Beta = .231), Warmth (Beta = -.304), and Radicalism (Beta = .217). The multiple correlation coefficient of this equation was .518, significant at the .01 level and accounting for 27% of the variance.

Females retained six factors significantly related to the SOLAT Left scale: Age (Beta = .192), Intelligence (Beta = -.172), Insecurity (Beta = .201), Warmth (Beta = .202), Radicalism (Beta = -.218), and Self-Discipline (Beta = .220). The multiple correlation coefficient for the equation was .476, significant at the .001 level. Roughly 23% of the association between the variables can be explained by these six factors.

Four factors were held in common by males and females: Intelligence, Insecurity, Warmth, and Radicalism. All but Insecurity, however, were correlated in opposite directions for the sexes.

SOLAT Right-Related Data

Three factors were retained for males in relationship to the SOLAT Right scale: Age (Beta = .310), Intelligence (Beta = -.527), and Self-Discipline (Beta = -.333). The equation's multiple correlation coefficient was .528, significant at the .001 level. About 28% of the variance may be attributed to these factors.

Females retained four factors: Impulsivity (Beta = .162), Shrewdness (Beta = .147), Radicalism (Beta = .211), and Self-Discipline (Beta = -.30). The multiple correlation coefficient was .446,

significant below the .001 level. These four factors account for approximately 20% of the variance between the variables.

Self-Discipline was the only factor held in common by males and females. Both coefficients were negative in valence.

SOLAT Integrated-Related Data

Only one factor was retained by males: Imagination (Beta = .351). The equation had a multiple correlation coefficient of .309, significant at the .05 level. This was, of course, not truly a multiple correlation coefficient but merely the correlation coefficient determined for that given factor. Barely 10% of the variance may be attributed to this factor.

Regression upon female sample data resulted in an equation holding three of the factors: Emotional Stability (Beta = .179), Shrewdness (Beta = -.143), and Self-Sufficiency (Beta = .209). The multiple correlation coefficient was .309, significant at the .01 level. Again, 10% of the variance was accounted for by these factors.

Table 29

Factors Retained Within Multiple Regression Equations--Males

Laterality factors	Beta	Mult. r
BP1		.478 **
Age	-.268 *	
4.1 Warmth	.272 *	
4.8 Self-Discipline	-.243	
SOLAT Left		.518 **
1.2 Intelligence	.339 **	
3.4 Insecurity	.231	
4.1 Warmth	-.304 *	
4.6 Radicalism	.217	
SOLAT Right		.528 ***
Age	.310 *	
1.2 Intelligence	-.527 ***	
4.8 Self-Discipline	-.333 **	
SOLAT Integrated		.309 *
1.1 Imagination	-.309 *	

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 30

Factors Retained Within Multiple Regression Equations--Females

Laterality factors	Beta	Mult. r
BPI		.458 ***
Age	-.197 *	
1.1 Imagination	.167 *	
4.1 Warmth	-.154	
4.8 Self-Discipline	-.359 ***	
SOLAT Left		.476 ***
Age	.192 *	
1.2 Intelligence	-.172 *	
3.4 Insecurity	.201 *	
4.1 Warmth	.202 **	
4.6 Radicalism	-.218 **	
4.8 Self-Discipline	.220 **	
SOLAT Right		.446 ***
3.2 Impulsivity	.162 *	
4.5 Shrewdness	.147	
4.6 Radicalism	.211 **	
4.8 Self-Discipline	-.300 ***	
SOLAT Integrated		.309 **
3.1 Emotional Stability	.179 *	
4.5 Shrewdness	-.143	
4.7 Self-Sufficiency	.209 **	

* $p < .05$ ** $p < .01$ *** $p < .001$

CHAPTER V

DISCUSSION OF THE RESULTS

Counseling, as a study of human behavior, must continually explore new findings which promise to cast new light upon the subject. For over 100 years it has been recognized that differences in the functions of the left and right cerebral hemispheres influence perception, information processing, and behavior. More recently, a number of studies have indicated that such differences (i.e., brain laterality) may be related to a number of areas of prime interest to those in the counseling profession.

Research has shown there to be an association between brain laterality and various elements of creative functioning. Some researchers have studied the relationship of laterality to occupational interests and have suggested a categorization of career clusters based upon preferred hemispheric functions. A significant body of evidence has related laterality to affective functioning in terms of emotional perception, expression, and precisposition--matters of crucial concern to counselors. A variety of other personality factors have also been associated with brain laterality by various researchers. Although a fair amount of data exists with regard to these obviously counseling-related concerns, such data is generally fragmented and has never been placed within a comprehensive and consistent frame of reference. Also, the

discussion of such data has not been oriented towards the needs and interests of the counseling professional.

The purpose of this study was to explore the relationship of brain laterality preference to a broad range of coherent personality factors and to suggest some areas to explore in future research. To this end, two measures of brain laterality preference were correlated with 29 factors derived from a single, comprehensive personality measure, utilizing a sample of 205 community college students. Both Pearson product moment correlation and multiple regression analysis were used to analyze the results.

This chapter will provide a summary of the results, followed by conclusions derived from this summarization. A section on possibly confounding influences will be followed by a discussion of the implications of the results and suggestions for further research.

Summary of Correlational Data

The Pearson product moment correlation technique was employed to obtain a measure of the relationships between the laterality scales and each of the factors within the four hypotheses. An alpha of .05 was utilized for these calculations. Correlations were relatively low throughout, but a number were significant beyond the .01 level. In terms of the confidence one may have in the data, significant corresponding correlations between laterality measures on a given factor provide some measure of confirmation. When such confirming data is evident, it will

be noted. The results are summarized below in relationship to each hypothesis.

Hypothesis One

The bivariate analysis of Hypothesis One factors indicated significant correlations on all three factors for males and on two of three scales for females. A clear relationship between LH laterality and intelligence emerged, though in opposite directions for males (positive) and females (negative). Imagination appeared to be related positively to LH preference and negatively to integrated preference for males. Creativity was more closely related to LH preference for males and to integrated functioning for females (for whom Creativity was also negatively correlated with RH preference).

Hypothesis Two

Significant correlations were found on five of six factors for males and on all six factors for females. LH preference had a positive relationship to the Artistic factor and a negative relationship to the Enterprising factor for males. For females, LH preference was indicated on four of the six factors: Realistic, Artistic, Enterprising, and Conventional--this preference being confirmed by negative correlations on RH preference for the Realistic and Artistic factors. It should be noted that these correlations were derived from the BPI scores and were not confirmed by SOLAT Left scale correlations.

RH preference was not positively related in any clear way to these career interest factors. However, significant negative correlations were found between RH preference and Investigative and Conventional factors for males; Realistic, Investigative and Artistic factors for females. The possible implications of this pattern for career choice and development will be explored in later sections.

Integrated preference was negatively related to the Social factor and positively correlated with the Realistic and Artistic factors for females. Males exhibited a positive correlation on both the Realistic and Enterprising factors related to integrated preferences.

Hypothesis Three

There seemed to be little, if any, significant relationship between laterality and the affective factors for men. This may have been an artifact of the small sample size or a reflection of the males' hesitation to candidly report their tendencies related to such factors. For females, however, a number of relationships emerged.

Bivariate analysis indicated a consistently positive relationship between RH preference and affective factors; most notably: Impulsivity, Suspiciousness, Insecurity, Tension, and Anxiety. Emotional Stability and Sensitivity were notable exceptions to this trend. It is interesting to note that the Integrated scale was positively correlated with Emotional Stability and negatively with four of the measures usually associated with affective dysfunction. This pattern suggests a possible link between integrated preferences and positive affective functioning. This link will be discussed further in terms of its implications.

Hypothesis Four

A number of significant relationships emerged for males and females with regard to the other general personality factors included under Hypothesis Four. The strongest relationships were evident for the Self-Discipline factor. For both males and females, a LH preference was positively related to this factor. For males, this relationship was based upon a negative BPI correlation; for females, a negative BPI correlation was confirmed by positive SOLAT Left and negative SOLAT Right correlations. Such results confirm the findings discussed in the review of the literature.

For males, there was a negative relationship between LH preference and Warmth and Boldness factors. BPI correlations indicated a LH preference related to Self-Sufficiency and Self-Discipline; a RH preference related to Extraversion. Males also exhibited a positive relationship between integrated preferences and Leadership. For females, LH preferences were positively related to Conformity and Self-Discipline factors; negatively with Radicalism and Independence (largely confirmed by negative correlations on the RH preference scale). These relationships might be related to the LH/occupational interest interaction--perhaps Conformity and Self-Discipline are more likely to be rewarded (in most jobs) than are Independence and Radicalism. Integrated preferences were negatively related to Warmth, Shrewdness, and Extraversion; positively with Self-Sufficiency and Self-Discipline.

Multiple Regression

A number of observations may be made concerning the data obtained by the regression analysis. One of the most obvious trends was the marked reduction of the number of factors contributing to each regression. An average of only three or four factors remained for each laterality scale. In addition, several factors were present in more than one equation (i.e., Age, Intelligence, Warmth, and Self-Discipline for males; Age, Warmth, Shrewdness, Radicalism, and Self-Discipline for females). Therefore, these factors appear to have the strongest unique relationship to the laterality scales. They also appear to share a common region of association with a variety of other factors found to be significantly correlated with laterality but not retained by the regression procedure.

Age was retained within the equation for the BPI for both males and females; and on one of the three scales of the SOLAT as well. This factor was not directly explored by this study but may merit future investigation.

The regression for the SOLAT Integrated scale resulted in the fewest factors and lowest multiple correlation coefficients for both sexes, perhaps reflecting a flexibility or a lack of consistency which makes prediction difficult. The SOLAT Left scale retained the largest number of factors for both sexes. If one follows the line of thought (suggested in the review of the literature) that this society as a whole is LH biased, it makes sense that young adults with such a preference would vary more consistently on traits thus reinforced.

Four factors were retained in common by males and females in relationship to the SOLAT Left scale: Intelligence, Insecurity, Warmth, and Radicalism. With the exception of Insecurity, however, the valences of the correlation coefficients were opposite--indicating significant sex differences in the way laterality interacts with such factors. Age and Self-Discipline were factors for females but not for males.

Only Self-Discipline was held in common by males and females in relationship to the SOLAT Right scale. Age and Intelligence were factors retained for males but not for females. Impulsivity, Shrewdness, and Radicalism were retained for females but not for males. Two elements of this equation were notable: (a) the negative correlation between RH preference and Intelligence for males ($r = -.527$) was the most potent association found in any of the regressions, and (b) Self-Discipline was negatively correlated to RH preference for both sexes.

Imagination was the sole factor retained for males in relationship to the SOLAT Integrated scale. Females had three different factors represented within their regression equation (i.e., Emotional Stability, Shrewdness, and Self-Sufficiency)--generally confirming the association of integrated laterality with personal adjustment.

The regression for the BPI resulted in three common factors for males and females: Age, Warmth, and Self-Discipline; with Warmth varying in opposite directions. The valence of the age correlations seems to indicate a move towards LH preferences with increasing age. This trend may relate to increasing social pressure from the LH-biased society in which such students are just starting to take active roles as adults. Females also retained Imagination in their equation.

It was also instructive to investigate the valence of those factors which were present in more than one equation . In the bivariate analyses, when two or more significant correlations were found for a given factor, the valences (i.e., the directions or signs of the correlation coefficients) would consistently confirm the nature of the relationship. This was also consistently the case for the regression. This kind of correspondence adds a good measure of confidence to the data.

For males, a positive relationship between Intelligence and LH preferences was somewhat confirmed by a negative relationship to RH preferences. Comparing the correlations between the SOLAT and the BPI resulted in a confirming relationship for Self-Discipline and Warmth.

For females, the Age, Warmth, Self-Discipline, and Radicalism factors had confirming relationships between different scales of the SOLAT or between the SOLAT and the BPI--strengthening the case for the nature of the relationship indicated by the correlation coefficients.

With few exceptions, the valence of the correlation coefficients within the regression equation confirmed the direction of relationship defined by the Pearson product moment correlations. Of all the correlations significant at the .05 level, only two factors varied in different directions; both related to the female sample. The bivariate analysis clearly indicated positive relationships between RH preferences and the Insecurity and Warmth factors; the regression indicated that these factors were positively correlated with LH preferences. Such a discrepancy reflects the effects of intercorrelation among a variety of related factors and is not uncommon in such a comparison. It does

suggest, however, caution in interpreting the data for these factors with regard to the female sample. From another perspective, the fact that confirming relationships predominate lends support to the overall validity of the findings.

Speculative Correlational Profiles

Tables 31-33 present profiles of personality characteristics significantly correlated with LH, RH, and integrated laterality preferences for both males and females. It must be noted again that, although clearly significant, these correlations are generally low and therefore not suitable for the interpretation of individual results. Given this understanding, one may procede to illustrate how such data (when refined by future research) could be used to interpret typical personality patterns. Such speculation is based upon the assumptions of clear-cut lateral dominance and linear correlations with personality factors that extend beyond the average range as the lateral dominance becomes more pronounced. Many of the interpretive conclusions are derived from the work of Karson and O'Dell (1976).

LH dominant profiles

Males with a clear LH preference are profiled as likely to be creative, intelligent, and able to exercise self-discipline. The clearer their LH preference, the more likely they are to be insightful and to have intellectual interests. Such persons are also more likely to be somewhat reserved, detached, critical, skeptical, cautious, even withdrawn. They are not likely to be attracted to spontaneous, daring,

or risky ventures; preferring a disciplined, restrained, and self-directed approach to things.

Females with a clear LH preference are profiled as somewhat dependent and more prone to neurosis. They are also likely to be self-disciplined and may use this trait to their advantage, in combination with their sensitivity, to lead others. They seem also to be likely to have a variety of non-intellectual interests and to have a conservative or traditional outlook.

RH dominant profiles

Males with a clear RH preference are more likely to be seen as warm-hearted, good-natured and outgoing persons than are their LH counterparts. They are also more likely to be generous, trustful, and expressive; and less likely to have abstract or intellectual interests. Their career interests will probably tend not to involve a large degree of analytical or detailed types of work, and they may be more likely to have difficulty in clearly defining such interests.

Females with a dominant RH preference appear to be more vulnerable to emotional ills. Their profile shows a tendency to be jealous, irritable, distrustful, fretful, frustrated, and uncontrolled in their behavior. They are also likely to be outgoing, gregarious, and sociable persons. Such persons are somewhat more likely to take a "tough-minded" approach to their and others' problems, yet may lack a creative or disciplined approach to these problems. Also, they (like the RH dominant males) may experience more difficulty than usual in defining the kinds of work they would like to do.

Integrated dominant profiles

Males with a dominant integrated preference appear to be more likely to take a concrete, "down-to-earth," practical, and conventional approach to life. They probably tend to be calm and stable in their reactions. They are somewhat more likely to enjoy persuading and leading others by appealing to basic and tangible factors that favor their intent; rarely will their "pitch" seem to be far-fetched, fanciful, unconventional, or particularly imaginative.

Females with a dominant integrated preference appear to tend toward a calm, stable, and well-adjusted personality profile. Rarely are they likely to seem overwrought, frustrated, or irritable. They may be more likely to have artistic interests than social ones and may prefer creative activities that involve tangible products. They are also likely to be disciplined, self-directed, and somewhat socially reserved.

Summary of profiles

As an exercise in informed speculation, the foregoing profiles bring to light a number of interesting considerations. LH dominant males appear to be creative and intellectual, yet detached and cautious towards the world. LH dominant females tend to be somewhat neurotic, dependent, and traditional; yet able to exercise leadership in a wide arena of tangible interests through the application of self-discipline and sensitivity. Both males and females in this category have a tendency to be disciplined and to have artistic interests.

RH dominant men seem to be friendly and sociable; and relatively uninterested in abstract or analytical tasks. RH dominant females

appear to be prone to a variety of dysfunctional traits and likely to "act-out" such problems. Both males and females who are RH dominant exhibit only negatively correlated career interest factors. Both sexes also exhibit a tendency to be outgoing, attentive to others, and actively focused upon the outer world.

Integrated dominant males are likely to be "down-to-earth" leaders, persuaders, or producers. Females with an integrated dominance tend to be creative and well-adjusted. Both males and females seem likely to feel secure and to have concrete, practical interests.

As further research refines the knowledge related to these considerations, practitioners using such data will be able to profile lateral dominance with a degree of confidence far beyond rudimentary speculation. However, this exercise does hopefully establish the possible usefulness of brain laterality preference in the understanding of personality and behavior--the foundation of counseling theory and practice.

Table 31

Summary of Significant LH Relationships

Males		Females	
Positive r	Negative r	Positive r	Negative r
Imagination	Warmth	Sensitivity	Intelligence
Intelligence	Boldness	Neurosis	Radicalism
Creativity	Enterprising	Conformity	Independence
Self-Sufficiency		Self-Discipline	
Self-Discipline		Leadership	
Artistic		Realistic	
		Artistic	
		Enterprising	
		Conventional	

Table 32

Summary of Significant RH Relationships

Males		Females	
Positive r	Negative r	Positive r	Negative r
Warmth	Intelligence	Suspiciousness	Creativity
Extraversion	Investigative	Impulsivity	Emot. Stabil.
	Conventional	Insecurity	Sensitivity
		Tension	Conformity
		Anxiety	Self-Discip.
		Warmth	Leadership
		Extraversion	Realistic
			Investigative
			Artistic

Table 33

Summary of Significant Integrated Relationships

Males		Females	
Positive r	Negative r	Positive r	Negative r
Realistic	Imagination	Creativity	Insecurity
Enterprising	Insecurity	Emot. Stabil.	Tension
Leadership		Realistic	Anxiety
		Artistic	Neurosis
		Self-Suffic.	Social
		Self-Discip.	Warmth
			Shrewdness
			Extraversion

Conclusions

Hypothesis One

The strongest relationships appeared between LH preferences and Intelligence and Creativity factors for males. Creativity, for females, was more closely related to integrated preferences.

Overall, for males, six of the 12 correlations within the matrix were significant; three of these at the .01 level. For females three of the 12 correlations were significant; two of them at the .01 level. For males, significant correlations were found on all three factors; for

females, two out of three factors exhibited at least one significant correlation. On this basis, Hypothesis One is rejected.

Hypothesis Two

LH and integrated preferences were usually positively correlated with career interest factors. RH preference seemed to be negatively related to most such factors. This pattern may reflect a cultural bias towards LH functions, as one might have predicted for a technologically-oriented society. The strongest relationships appeared for the Investigative factor for males; the Realistic, Artistic and Conventional factors for females. All of these relationships involved at least two significant and confirming correlation coefficients.

Overall, for males, significant correlations were found on five out of six factors; with a total of seven significant correlations within a 24 correlation matrix. For females, at least one significant correlation was found related to every factor. A total of 11 significant correlations were found within the correlation matrix. On this basis, Hypothesis Two is rejected.

Hypothesis Three

There seemed to be evidence in support of a relationship between laterality and several elements of affective functioning for females. No such evidence was present for males. For females, the strongest relationships were present for the Suspiciousness, Tension, Sensitivity, and Anxiety factors--all having at least two confirming correlations and

all but one having a correlation coefficient significant at the .01 level of significance.

Overall, for females, eight of the nine factors had at least one significant correlation. Out of a matrix of 36 factors, females had a total of 17 significant correlations; ten of these at the .01 level of significance. On this basis, Hypothesis Three is rejected.

Hypothesis Four

Laterality preference seemed to be significantly related to several factors within Hypothesis Four. Significant correlations focused upon BPI results for males but were distributed evenly among all scales for females. For males, only the Warmth relationship was confirmed by two significant correlations; five factors were so confirmed for females. For females, Conformity and Self-Discipline showed the strongest relationships, with at least three significant correlations which varied in appropriately confirming directions.

Overall, for males, six of the 11 factors had significant correlations. This number increased to nine out of 11 for the female sample. The matrix was composed of 44 correlations. For males, seven significant correlations were found, two of them at the .01 level of significance. For females, 17 of the 44 correlations were found to be significant, eight of these at the .01 level. On this basis, Hypothesis Four is rejected.

Multiple Regression

In every case, the regression analysis resulted in multiple correlation coefficients greater than .30, with most in the range between .45 and .52. One equation was significant at the .05 level, three at the .01 level, and four at the .001 level or beyond. This evidence indicated a definitive relationship between laterality and personality factors. It must also be noted that the highest coefficient of determination was only in the range of .25 (i.e., only 25% of the variance being accounted for by the variables being considered). Also, in several of the regressions Hypothesis Four factors seemed to predominate. Perhaps a clearer categorization of factors within this "other personality factors" group would be worthwhile.

Confounding Influences

There are several considerations related to the results of this study which merit further discussion. This section will explore some of the factors which may have influenced the results in some way.

Sample Distribution

The greater number of females (and the resulting relatively small male sample size) may have affected the results related to males. Since a smaller sample required more stringent tests of significance, a larger sample of males may have resulted in more significant results for this subgroup. This factor was more significant because of the sex

differences found within the study. The elimination of sinistrals from the sample may have also influenced the results. Further research may be indicated to explore the effects of handedness.

The BPI scores also clustered in a narrow range on the scale. The scores may vary from 38 to 255. Based upon the standard deviation, however, over 68% of the scores fell between 114 and 159. Such a relatively homogeneous sample may have negatively influenced the number and strength of significant correlations.

Age

Age was found to be positively correlated to brain laterality measures for both males and females. For males, age was retained in the regression equations for the BPI (Beta= -.268) and the SOLAT Right scale (Beta=.310). For females, age was retained for the BPI (Beta= -.197) and the SOLAT Left scale (Beta=.192). To complicate this further, a significant difference was found between males and females on age (male mean= 21.8; female mean= 24.7). Increasing age therefore seems to relate to a move towards LH preference for females; the direction is unclear for males. The nature of these relationships indicated a possible confounding influence on the results.

The average ages for these students, though typical for a community college, are probably not typical of other college and university undergraduate populations. This possible lack of correspondence limits the generalizability of the results.

Instrumentation

The limitations of the instruments used to measure brain laterality were discussed in Chapter III. As the technique of such measurement is refined, the results of studies such as this one can be viewed with an enhanced level of confidence. Both instruments utilized a "forced-choice" format which automatically limits the range of response variability. Perhaps a Likert-type scale measuring the same construct would produce different results.

Although the BPI and SOLAT generally confirmed each other in relationship to the factors, the correspondence between instruments was lower than one might expect, given the similarities of the instruments' construction and theoretical bases. This is probably due to psychometric factors related to item weighting in the BPI. Certainly, further research is needed in this area.

Implications of the Findings

The results of the study raise a number of interesting theoretical considerations. These considerations will be reviewed in terms of the four general areas categorized within the hypotheses. The writer recognizes the significant limitations imposed by external validity. Because of differing samples, this study is directly comparable to few if any of the previous studies cited in the review of the literature. The purpose of this section, however, is to exercise theoretical speculation and suggest practical implications.

Those sections which suggest practical considerations for counseling are most appropriate and valid for those counselors working with a population similar in nature to the sample utilized within the study. Because of the exploratory nature of this research, it is suggested that such practical considerations be applied only experimentally (or not at all) until further research clarifies and enhances the evidence in this field. The primary purpose in presenting such considerations is to stimulate such further study.

Implications for Creative Functioning

The review of the literature clearly suggested a positive relationship between creative functioning and RH preference (e.g., Edwards, 1979; Olson, 1977; Torrance & Reynolds, 1980; Wheatley, 1977). There was also support for the importance of an integrated mode of processing in creative endeavors (e.g., Hermann, 1982; Osborn, 1963; Sanders & Sanders, 1984). This study supported the relationship of creativity and integrated preferences for females. However, it was LH preferences rather than RH preferences which were positively related to creativity factors for both sexes. This evidence may suggest that LH functions are more vital to creativity for individuals of average creativity without precluding an increasing role for RH functions as the level of creative potential increases.

Because of this discrepancy, the implications for counselors are unclear. Theory holds that the RH is the key to creativity; yet this is unsupported by this study. At least for females, certain techniques which facilitate integrated functioning may provide tools for counselors

working to enhance creativity. Such techniques have been presented by Wonder and Donovan (1984), Edwards (1979), de Bono (1970) and others.

Implications for Occupational Interests

The review of the literature cited the work of several researchers who have delineated occupational differences based upon brain laterality (e.g., Coulson & Strickland, 1983; Goodspeed, 1983). This study produced a variety of relationships concerned with career interest factors. Such relationships are far from definitive, however, and require clarification before application is justified.

The results of some other factors may be useful in terms of career interests. As mentioned before, there was a clear relationship between LH preference and the Creativity-related factors. Krug (1980) cited research that linked high scores on these factors to artistic and research-related occupations; low scores to mechanical jobs. Warmth is another factor with similar implications. Krug (1980) cited research which correlated high Warmth scores to counseling, social work, and middle management types of occupations. Artists and researchers were cited as examples of low scoring occupations.

Krug (1980) also cited research which related the Warmth factor to counseling effectiveness. This study's results indicated that Warmth is positively related to RH preferences. Perhaps the intentional enhancement of these preferences would indirectly affect counseling effectiveness. Also, persons high in Imagination (more likely to be females with RH preferences and males with integrated preferences) are more likely to change jobs and less likely to obtain promotions (cited in

Krug, 1980). Such information may be useful to those counselors working with job placement or employee assistance programs. Also, females with integrated laterality preferences and males with LH preferences may be more likely to want to work alone, under their own direction, since they tend towards Self-Sufficiency and Self-Discipline.

In general, the results seem to reflect a cultural bias towards LH functioning in relationship to occupational interests. Skills of analysis, logic, and critical thinking are certainly fundamental to an industrialized economy; and it is this economy which provides the majority of jobs. Such a trend may indicate career development problems for those persons with clearly delineated RH preferences.

Implications for Affective Functioning

The predominance of research literature seemed to indicate the relationship of RH preference to emotional perception (e.g., Ley & Bryden, 1982), emotional expression (e.g., Borod & Caron, 1980), and a predisposition to negative emotions (e.g., Deglin, 1976).

These views draw significant support from study data which indicated a significant negative correlation between RH preference and Self-Discipline for males and females. Krug (1980) cited evidence for the positive relationship between Self-Discipline and personal adjustment. In addition, for females in this study, there was a clearcut positive relationship between RH preferences and emotional factors usually considered to be dysfunctional. This evidence may be taken as some justification for counselors to study the possible cultivation of

integrated laterality functions for those persons suffering from negative emotions of the type measured in this study.

Janov and Holden (1975) and Parrott (1984) suggested that better adjusted persons would have a more balanced or integrated laterality preference. In support of this view, the study results indicated that an integrated preference is positively correlated with the Emotional Stability factor for females and negatively with a number of affective factors usually associated with dysfunctional behavior.

The positive relationship between integrated laterality preferences and Emotional Stability (evidenced only for females in this study) is also significant for counselors. Low scorers on this factor are prone to accidents, physical illness, emotional frustration, indecisiveness, evasion of responsibility, and a variety of other disorders (Karson & O'Dell, 1976; Krug, 1980). If a causal relationship was determined by later research, the enhancement of integrated laterality could be used as a tool for personal growth. This, in fact, was a claim that Janov and Holden (1975) made for Primal Therapy.

Tucker (1981) also suggested that the LH plays the key role in the monitoring and control of behavior. This role was confirmed by study findings which showed a positive correlation between LH preferences and the Self-Discipline factor for both sexes. Counselors may take special note of the role of LH functioning in the control of behavior. The relationship between laterality and Self-Discipline was one of the clearcut findings of the study.

The role of the LH in behavior control may be viewed from two different perspectives. Persons with strong RH preferences may be more

likely to have lower levels of Self-Discipline and therefore experience problems related to acting-out, expedient decision-making, and carelessness with regard to social (and possibly legal) conventions. From another perspective, persons with strong LH preferences may be more likely to be overcontrolled or compulsive in their behavior.

Implications for Other Personality Factors

Chapter II presented a variety of other personality variables which were hypothesized to be related to laterality by various authors and researchers. Some of the results of this study provide additional information related to such hypotheses.

Wonder and Donovan (1984) suggested that those with a LH preference would tend to be more organized, neat, self-disciplined, talkative, and skeptical. The evidence from this study supported the positive relationship between LH preference and Self-Discipline (related to control, organization, and neatness).

Day (1964, 1967), Bakan (1969), and Ehrlichman and Weinberger (1978) suggested that those with RH preferences are more inner directed or reflective, while those with LH preferences are more likely to project themselves into the external world. In females, a positive correlation between RH preference and the Impulsivity factor (high scores indicating an expressive acting-out and enthusiasm; low scores an introspective internalization or reflective tendency) seemed to directly conflict with the earlier evidence; as did the positive correlation found between RH preferences and Extraversion for both sexes.

Hampton-Turner (1981) suggested a relationship between RH preference, less deference, and more attitudinal independence. The negative relationship found between LH preference and Radicalism (free-thinking, unbound by tradition) and Independence for females seemed to support this; as did the significant negative relationship between RH preferences and Conformity.

Once the "state-of-the-art" of laterality measurement and research is enhanced, counselors may have another tool with which to profitably profile client characteristics. The relationship of laterality to such a variety of significant personality factors indicates that it may become a powerful tool in explaining human behavior. Evidence that laterality may be influenced intentionally (e.g., Wonder & Donovan, 1984; Edwards, 1979) suggests that it may also one day provide a tool to help change behavior--one of the primary goals of the counseling profession.

Suggestions for Further Research

The stimulation of further research is an implied objective of most research. It is of particular importance in relationship to exploratory research focused upon speculative issues. This section will suggest several avenues of further research which could build upon the results of this study.

Research on Creativity

A major discrepancy between the evidence presented in the review of the literature and the results of this study has to do with hemispheric

correlates of creativity. It is unclear whether the consistent association found between LH preferences and creative functioning is a peculiarity of the sample, the instrumentation, the range of scores, or some other factor. Further research aimed at clarification of this issue would be most beneficial.

Research on Affective Functioning

The relationship of affective variables to RH and integrated preferences for females was one of the most clearcut outcomes of this study. The dialectic interaction of such preferences as they are related to indicators of mental health and personal well-being should be of particular interest to those in the counseling profession. In addition, the lack of meaningful correlations for males was striking and deserves further examination.

Research on Sex Differences

This study uncovered significant sex differences in the way personality factors are correlated to brain laterality preference. Sex differences were addressed within this study, not as a hypothesis, but as an element of the analysis useful in determining the appropriate presentation of data. The magnitude of the differences uncovered by this study clearly justifies further research specifically directed at the nature of such differences.

Research on Cultural Differences

Though not an element of this study, the review of the literature established the paucity of data related to cultural differences and brain laterality. The few studies that exist focus primarily upon Native Americans--no studies were found that provided data on a Black or Hispanic sample, for example. Sue (1981) made the connection between brain laterality and implications for cross-cultural counseling. This is an area ripe for further study.

Research on Laterality Measurement

The experimental nature of psychometric measurement of brain laterality imposes restrictions upon research in this area. Such instruments make research with large and varied samples feasible as never before. There is, however, considerable room for further development. Of particular value would be research which directly correlated self-reported preferences to a more objective measure of lateral activation (e.g., electroencephalogram or cerebral blood flow measurement devices).

Other Instruments

The 16PF was selected for this study because of its well-established reliability and validity, and due to its comprehensive coverage of a wide array of counseling-related personality factors. The research of Taggart and Robey (1981) (relating the Myers-Briggs Type Indicator to laterality) may indicate another fruitful direction of study.

As mentioned previously, the coefficients of determination clearly indicated that laterality is influenced by factors other than the personality factors present within this study. Other measures such as the Personal Orientation Inventory, the Rotter I-E measure of locus of control, the Career Maturity Inventory, the Orientation Inventory, and the Work Environment Scale would provide interesting avenues of research in relationship to a measure of brain laterality. In addition, the results related to affective functioning suggest further research with instruments oriented towards such factors.

The occupational interest scores on the 16PF were of somewhat limited usefulness because they were composite scores, based upon personality measurement, rather than direct measures of career interests. A study utilizing a direct measure of career interest (e.g., The Strong-Campbell Interest Inventory or the Self-Directed Search) might provide more useful and significant data related to this important counseling area.

Experimental Studies

One of the weaknesses of this study was related to the exercise of experimental control. This weakness was tolerated due to the exploratory nature of the study. Future studies, however, would benefit from the institution of more elements of experimental control in the examination of more narrowly defined research hypotheses. This would enhance the internal and external validity of the results, thus enhancing the confidence with which they may be applied.

Research With Other Samples

One of the objectives of using a general community college sample was to establish a baseline for comparison in relationship to specific subpopulations. The study of such subpopulations could also be expanded to the study of other populations (e.g, university students, adults). Future research might also include sinistrals as an element of the analysis in order to confirm the possible influence of handedness on laterality. Another suggestion would be a study which based its analysis upon the data of only those individuals with clearly delineated preference--either clearly LH or RH oriented.

There is also a need for research related to a variety of different occupational groups. The research in this area (e.g., Goodspeed, 1983; Coulson & Strickland, 1983) is limited, requiring expansion and validation. The selection of a stratified sample of technical, social service, or artistic occupational groups might better serve such a purpose.

Research which further explored Agor's (1983) work on organizational characteristics related to laterality would have definite implications for career counselors. The management decision styles proposed by Taggart and Robey (1981) are also promising in this regard.

The study of specific client subpopulations may also be a fruitful area for examination. Samples of clients who are experiencing vocational indecision or specific types of emotional disorders may be suitable for such studies. Women experiencing adjustment problems might also be a target group, given the evidence linking such problems with RH preferences.

Research Related to Counseling Processes

The support that this study provided to the relationship between laterality and affective factors might also suggest further study in regard to the counseling process itself. The relationship of laterality to different counseling techniques is an example, as would be the correlation with the choice to use given techniques or their relative effectiveness with different persons.

There are a number of research directions related to counseling skills which may be beneficially explored. For example, the literature review indicated a number of significant relationships between brain laterality and the perception of emotions (e.g., Ley & Bryden, 1982; Suberi & McKeever, 1977). Since such perception is such a crucial element of counseling, it merits further study.

A number of studies have explored laterality in relationship to unconscious processes such as repression and denial (e.g., Blakeslee, 1980; Janov & Holden, 1975). Such processes are fundamental to an understanding of human behavior and require further research to clarify the variables involved. The evidence for hemispheric-related emotional predispositions (e.g., Deglin, 1976; Natale, Gur, & Gur, 1983) has obvious implications for counseling. Research into this particular aspect of laterality may shed more light upon the elements contributing to a person's basic emotional outlook.

The avenues of further research in this area are limited only by the imagination and resources of the investigator. The groundwork is beginning to be laid for an exciting and potentially illuminating exploration into significant elements of human behavior.

REFERENCES

Agor, W.H. (1983, April). Brain skills development in management training. Training and Development Journal, 37, 78-83.

Akelaitis, A.J. (1941a). Psychobiological studies following section of the corpus callosum: A preliminary report. American Journal of Psychiatry, 97, 1147-1157.

Akelaitis, A.J. (1941b). Studies on the corpus callosum: II. The higher visual functions in each homonymous field following complete section of the corpus collosum. Archives of Neurology and Psychiatry, 45, 788-796.

Akelaitis, A.J. (1941c). Studies on the corpus callosum: VIII. The effects of partial and complete section of the corpus callosum on psychopathic epileptics. American Journal of Psychiatry, 98, 409-414.

Akelaitis, A.J. (1942a). Studies on the corpus callosum: V. Homonymous defects for color, object and letter recognition (homonymous hemiamblyopia) before and after section of the corpus callosum. Archives of Neurology and Psychiatry, 48, 108-118.

Akelaitis, A.J. (1942b). Studies on the corpus callosum: VI. Orientation (temporal-spatial gnosis) following section of the corpus callosum. Archives of Neurology and Psychiatry, 48, 914-937.

Akelaitis, A.J. (1943). Studies on the corpus callosum: VII. Study of language functions (tactile and visual lexia and graphia) unilaterally following section of the corpus callosum. Journal of Neuropathology and Experimental Neurology, 2, 226-262.

Akelaitis, A.J. (1944). A study of gnosis, praxis and language following section of the corpus callosum and anterior commissure. Journal of Neurosurgery, 1, 94-102.

Akelaitis, A.J., & Risteen, W.A., Herren, R.Y.,& Van Wagenen, W.P. (1942). Studies on the corpus callosum: III. A contribution to the study of dyspraxia in epileptics following partial and complete section of the corpus callosum. Archives of Neurology and Psychiatry, 47, 971-1008.

Akelaitis, A.J., Risteen, W.A., & Van Wagenen, W.P. (1943). Studies on the corpus callosum: IX. Relationship of the grasp reflex to section of the corpus callosum. Archives of Neurology and Psychiatry, 49, 820-825.

Albert, M.L., & Obler, L.K. (1978). The bilingual brain: Neuropsychological and neurolinguistic aspects of bilingualism. New York: Academic.

Allen, M. (1983). Models of hemispheric specialization. Psychological Bulletin, 93, 73-104.

Alwitt, L.F. (1981). Two neural mechanisms related to modes of selected attention. Journal of Experimental Psychology: Human Perception and Performance, 7, 324-332.

Annett, M. (1967). The binomial distribution of right, mixed, and left handedness. Quarterly Journal of Experimental Psychology, 19, 327-333.

Annett, M. (1972). The distribution of manual asymmetry. British Journal of Psychology, 63, 343-358.

Annett, M. (1975). Hand preference and the laterality of cerebral speech. Cortex, 11, 305-328.

Bakan, P. (1969). Hypnotizability, laterality of eye movement and functional brain asymmetry. Perceptual and Motor Skills, 28, 927-932.

Bakan, P. (1971, April). The eyes have it. Psychology Today, pp. 64-67; 96.

Bakan, P. (1976, November). The right brain is the dreamer. Psychology Today, pp. 66-68.

Bakan, P., & Svorad, D. (1969). Resting EEG alpha and asymmetry of reflective lateral eye movements. Nature, 223, 975-976.

Barchas, P.R., Jose II, W.S., Payne, B.A., & Harris, W.A. (1984). An attention regulating function of social hierarchies: High status, attention and the brain evoked potential, CNV. In P.R. Barchas (Ed.), Social hierarchies: Essays toward a socio-physiological perspective. Westport, CT: Greenwood.

Barchas, P.R., Harris, W.A., Jose II, W.S., & Rosa, E.A. (1984). Social interaction and the brain's lateralization of hemispheric function. In P.R. Barchas, & S.P. Mendoza (Eds.), Social cohesion. Westport, CT: Greenwood.

Barnat, M.R. (1974). Some personality correlates of the conjugate lateral eye-movement phenomenon. Journal of Personality Assessment, 38, 223-225.

Beaumont, J.G. (1981). Activation and interference in tactile perception. Neuropsychologia, 19, 151-154.

Benowitz, L.I., Bear, D.M., Rosenthal, R., Mesulam, M.M., Zaidel, E., & Sperry, R.W. (1983). Hemispheric specialization in nonverbal communication. Cortex, 19, 5-11.

Benton, A.L. (1980). The neuropsychology of facial recognition. American Psychologist, 35, 176-186.

Benton, A.L., Hannay, H.J., & Varney, N.R. (1975). Visual perception of line direction in patients with unilateral brain disease. Neurology, 25, 907-910.

Berne, E. (1964). Games people play. New York: Random House.

Bever, T.G., & Chiarello, R.J. (1974). Cerebral dominance in musicians and non-musicians. Science, 185, 537-539.

Blakeslee, T.R. (1980). The right brain. New York: Anchor.

Blumstein, S., & Cooper, W.E. (1974). Cortex, 10, 146-158.

Bogen, J. (1969a). The other side of the brain I: Dysgraphia and dyscopia following cerebral commissurotomy. Bulletin of the Los Angeles Neurological Societies, 34, 73-105.

Bogen, J. (1969b). The other side of the brain II: An appositional mind. Bulletin of the Los Angeles Neurological Societies, 34, 135-162.

Bogen, J. (1977). Some educational implications of hemispheric specialization. In McWittrock (Ed.), The human brain. Englewood Cliffs, CA: Prentice-Hall.

Bogen, J.E., & Bogen, G.M. (1969). The other side of the brain III: The corpus callosum and creativity. Bulletin of the Los Angeles Neurological Societies, 34, 191-217.

Bogen, J.E., & Bogen, P.J. (1963). Treatment of generalized seizures by cerebral commissurotomy. Surgical Forum, 14, 431.

Bogen, J., & Vogel, P.J. (1962). Cerebral commissurotomy in man. Preliminary case report. Bulletin of the Los Angeles Neurological Society, 27, 169-172.

Borod, J.C., & Caron, H.S. (1980). Facedness and emotion related to lateral dominance, sex and expression type. Neuropsychologia, 18, 237-241.

Bouma, A., & Ippel, M.J. (1983). Individual differences in mode of processing in visual asymmetry tasks. Cortex, 19, 51-67.

Bowers, D., & Heilman, K.M. (1980). Material-specific hemispheric activation. Neuropsychologia, 18, 309-320.

Bradshaw, J.L., & Nettleton, N.C. (1981). The nature of hemispheric specialization in man. The Behavioral and Brain Sciences, 4, 51-92.

Bradshaw, J.L., Nettleton, N.C., & Taylor, M.J. (1980). An information-retrieval system for classifying work in the field of cerebral asymmetry. Perceptual and Motor Skills, 50, 491-494.

Broadbent, D.E. (1974). Division of function and integration of behavior. In F.O. Schmitt, & F.G. Worden (Eds.), The neurosciences: Third study program. Cambridge, MA: MIT.

Bryden, M.P. (1979). Evidence for sex differences in cerebral organization. In M. Wittig, & A. Peterson (Eds.), Determinants of sex-related differences in cognitive functioning. New York: Academic.

Bryden, M.P. (1982). Laterality: Functional asymmetry in the intact brain. New York: Academic.

Bryden, M.P., & Allard, F. (1976). Visual hemifield differences depend on typeface. Brain and Language, 3, 191-200.

Bryden, M.P., & Sprott, D.A. (1981). Statistical determination of degree of laterality. Neuropsychologia, 19, 571-581.

Campbell, D.P., & Hansen, J.C. (1981). Manual for the SVIB-SCII. Stanford, CA: Stanford University.

Campbell, D.T., & Stanley, J.C. (1963). Experimental and quasi-experimental designs for research. Chicago: Rand McNally.

Canadian study frames new right/left paradigm. (1983, March). Brain Mind Bulletin, pp. 1; 3.

Cattell, R.B., Eber, H.W., & Tatsuoka, M.M. (1970). Handbook for the Sixteen Personality Factor Questionnaire (16PF). Champaign, IL: IPAT.

Chiarello, C.A. (1980). A house divided? Cognitive functioning with callosal agenesis. Brain and Language, 11, 128-158.

Cohen, G. (1973). Hemispheric differences in serial vs. parallel processing. Journal of Experimental Psychology, 97, 349-356.

Corballis, M.C. (1983). Human laterality. New York: Academic.

Coren, S., & Kaplan, C.P. (1973). Patterns of ocular dominance. American Journal of Optometry and Archives of American Academy of Optometry, 50, 283-292.

Coulson, L.T., & Strickland, A.G. (1983). The minds at the top: An analysis of the thinking style preferences of superintendents of schools and chief executive officers. Journal of Creative Behavior, 17, 163-173.

Crowder, R.G. (1973). Representation of speech sounds in precategorical acoustic storage. Journal of Experimental Psychology, 98, 14-24.

Dabbs, J.M. (1980). Left-right differences in cerebral blood flow and cognition. Psychophysiology, 17, 548- 551.

Dabbs, J.M., & Choo, G. (1980). Left-right carotid blood flow predicts specialized mental ability. Neuropsychologia, 18, 711-713.

Darwin, C.J. (1974). Ear differences and hemispheric specialization. In F.O. Schmitt, & F.G. Worder (Eds.), The neurosciences: Third study program. Cambridge, MA: MIT.

Davidoff, J. (1975). Hemispheric differences in the perception of lightness. Neuropsychologia, 13, 121-124.

Davidoff, J. (1976). Hemispheric sensitivity differences in the perception of colour. Quarterly Journal of Experimental Psychology, 28, 387-394.

Davidson, R.J., & Schwartz, J.E. (1977). The influence of musical training on patterns of EEG asymmetry during musical and nonmusical self-generation tasks. Psychophysiology, 14, 58-63.

Day, M.E. (1964). An eye movement phenomenon relating to attention, thought and anxiety. Perceptual and Motor Skills, 19, 443-446.

Day, M.E. (1967). An eye-movement indicator of individual differences in the physiological organization of attentional processes and anxiety. Journal of Psychology, 66, 51-62.

de Bono, E. (1970). Lateral thinking. New York: Harper & Row.

Deglin, V. (1976, January). Split brain. The Unesco Courier, pp. 5-32.

DeRenzi, E. (1978). Hemispheric asymmetry as evidenced by spatial disorders. In M. Kinsbourne (Ed.), Asymmetrical function of the human brain. New York: Academic.

Dimond, S.J., & Beaumont, J.G. (1974). Experimental studies of hemisphere function in the human brain. In S.J. Dimond, & J.G. Beaumont (Eds.), Hemisphere function in the human brain. New York: Halstead.

Donchin, E., Kutas, M., & McCarthy, G. (1977). Electrocortical indices of hemispheric utilization. In S. Harnad, R.W. Doty, L. Goldstein, J. Jaynes, & G. Krauthamer (Eds.), Lateralization in the nervous system. New York: Academic.

Durnford, M., & Kimura, D. (1971). Right hemisphere specialization for depth perception reflected in visual field differences. Nature, 231, 394-395.

Edwards, B. (1979). Drawing on the right side of the brain. Los Angeles: Tarcher.

Ehrlichmann, H. (1972). Hemispheric functioning and individual differences in cognitive abilities. (Doctoral dissertation, New School for Social Research, 1971). Dissertation Abstracts International, 33, 2319B.

Ehrlichmann, H., & Weinberger, A. (1978). Lateral eye movements and hemispheric asymmetry: A critical review. Psychological Bulletin, 85, 1080-1101.

Ellenberg, L., & Sperry, R.W. (1980). Lateralized division of attention in the commissurotomized and intact brain. Neuropsychologia, 18, 411-418.

Etaugh, C. (1972). Personality correlates of lateral eye movements and handedness. Perceptual and Motor Skills, 34, 751-754.

Etaugh, C., & Rose, M. (1973). Lateral eye movement: Elusive personality correlates and moderate stability estimates. Perceptual and Motor Skills, 37, 211-217.

Frumkin, L.R., Ripley, H.S., & Cox, G.B. (1978). Changes in cerebral hemispheric lateralization with hypnosis. Biological Psychiatry, 13, 741-750.

Gainotti, G. (1972). Emotional behavior and hemispheric side of the lesion. Cortex, 8, 41-55.

Galin, D. (1974). Implications for psychiatry of left and right cerebral specialization. Archives of General Psychiatry, 31, 572-583.

Galin, D., & Ornstein, R. (1973). Hemispheric specialization and the duality of consciousness. In H. Wydoe (Ed.), Human behavior and brain function. Springfield, IL: Thomas.

Galin, D., & Ornstein, R. (1974). Individual differences in cognitive style-I. Reflective eye movements. Neuropsychologia, 12, 367-376.

Garrett, S.V. (1976). Putting our whole brain to use: A fresh look at the creative process. Journal of Creative Behavior, 10(4), 239-249.

Gazzaniga, M. (1970). The bisected brain. New York: Appleton.

Gazzaniga, M. (1974). Cerebral dominance viewed as a decision system. In S. Dimond & J.G. Beaumont (Eds.), Hemisphere function in the human brain. New York: Wiley.

Gazzaniga, M., Bogen, J.E., & Sperry, R.W. (1962). Some functional effects of sectioning the cerebral commissures in man. Proceedings of the National Academy of Sciences, 48, 1765-1769.

Gazzaniga, M., & LeDoux, J.E. (1978). The integrated mind. New York: Plenum.

Gazzaniga, M., & Sperry, R.W. (1967). Language after section of the cerebral commissures. Brain, 90, 131-148.

Gazzaniga, M.S., Volpe, B.T., Smylie, C.S., Wilson, D.H., & LeDoux, J.E. (1979). Plasticity in speech organization following commissurotomy. Brain, 102, 808-815.

Geschwind, N., & Levitsky, W. (1968). Human brain: Left-right asymmetries in temporal speech region. Science, 161, 186-187.

Goleman, D. (1977, October). Split-brain psychology: Fad of the year. Psychology Today, pp. 89-90; 149.

Goodspeed, B.W. (1983). The Tao-Jones averages: A guide to whole-brained investing. New York: Dutton.

Gordon, H.W. (1970). Hemispheric asymmetries in the perception of musical chords. Cortex, 6, 387-398.

Gorovitz, E.S. (1982, December). The creative brain II: A revisit with Ned Herrmann. Training and Development Journal, 36, 74-88.

Gross, Y., Franko, R., & Lewin, I. (1978). Effects of voluntary eye movements on hemispheric activity and choice of cognitive mode. Neuropsychologia, 16, 653-657.

Guiard, Y., & Requin, J. (1977). Interhemispheric sharing of signals and responses and the psychological refractory period. Neuropsychologia, 15, 427-438.

Gur, R.C., & Gur, R.E. (1974). Handedness, sex, and eyedness as moderating variables in the relation between hypnotic susceptibility and functional brain asymmetry. Journal of Abnormal Psychology, 83, 635-643.

Gur, R.C., & Gur, R.E. (1980). Handedness and individual differences in hemispheric activation. In J. Herron (Ed.), Neuropsychology of left-handedness. New York: Academic.

Gur, R.C., Gur, R.E., Rosen, A.D., Warach, S., Alavi, A., Greenberg, J., & Reivich, M. (1983). A cognitive-motor network demonstrated by positron emission tomography. Neuropsychologia, 21, 601-606.

Gur, R.E. (1977). Motoric laterality imbalance in schizophrenia. Archives of General Psychiatry, 34, 33.

Gur, R.E. (1978). Left hemisphere dysfunction and left hemisphere overactivation in schizophrenia. Journal of Abnormal Psychology, 87, 226.

Gur, R.E., & Gur, R.C. (1975). Defense mechanisms, psychosomatic symptomatology, and conjugate lateral eye movements. Journal of Consulting and Clinical Psychology, 43, 416-420.

Gur, R.E., & Gur, R.C. (1977). Correlates of conjugate lateral eye movements in man. In Harnad et al. (Eds.), Lateralization in the nervous system. New York: Academic Press.

Gur, R.E., Gur, R.C., & Marshalek, B. (1975). Classroom seating and functional brain asymmetry. Journal of Educational Psychology, 67, 151-153.

Hampden-Turner, C. (1981). Maps of the mind. New York: Macmillan.

Hannay, H.J., Varney, N.R., & Benton, A.L. (1976). Visual localization in patients with unilateral brain disease. Journal of Neurology, Neurosurgery & Psychiatry, 39, 307-313.

Harris, L. (1978). Sex differences and spatial ability: Possible environmental, genetic, and neurological factors. In M. Kinsbourne (Ed.), Asymmetrical function of the brain. London: Cambridge.

Harris, L. (1980). Which hand is the "eye" of the blind - A new look at an old question. In J. Herron (Ed.), Neuropsychology of left handedness. New York: Academic.

Hartmann, T. (1984, November). The synchro-energizer. Popular Computing, pp. 50-51.

Hartwig, F., & Dearing, B.E. (1979). Exploratory data analysis. Beverly Hills, CA: Sage.

Hecaen, H., & Angelergues, R. (1962). Agnosia for faces (prosopagnosia). A.M.A. Archives of Neurology, 7, 92-100.

Hecaen, H., DeAgostini, M., & Monzon-Montes, A. (1981). Cerebral organization in left-handers. Brain and Language, 12, 261-284.

Hecaen, H., Penfield, W., Bertrand, C., & Malmo, R. (1956). The syndrome of apractognosia due to lesions of the minor cerebral hemisphere. Archives of Neurology and Psychiatry, 75, 400-434.

Hecaen, H., & Sauguet, J. (1971). Cerebral dominance in left-handed subjects. Cortex, 7, 19-48.

Heilman, K.M. (1979). Apraxia. In K.M. Heilman & E. Valenstein (Eds.), Clinical neuropsychology. Oxford, England: Oxford University Press.

Heilman, K.M., Scholes, R., & Watson, R.T. (1975). Auditory affective agnosia: Disturbed comprehension of affective speech. Journal of Neurology, Neurosurgery, and Psychiatry, 38, 69-72.

Hellige, J.B. (1978). Visual laterality patterns for pure-versus mixed-list presentation. Journal of Experimental Psychology: Human Perception and Performance, 4, 121-131.

Hermann, N. (1981, October). The creative brain. Training and Development Journal, 35, 11-16.

Herron, J. (1980). Two hands, two brains, two sexes. In J. Herron (Ed.), Neuropsychology of left-handedness. New York: Academic.

Hines, D., Sawyer, P.K., Dura, J., Gilchrist, J., & Czerwinski, M. (1984). Hemispheric asymmetry in use of semantic category information. Neuropsychologia, 22, 427-433.

Hirshkowitz, M., Earle, J., & Paley, B. (1978). EEG alpha asymmetry in musicians and nonmusicians: A study of hemispheric specialization. Neuropsychologia, 16, 125-128.

Hutt, C. (1972). Males and females. Middlesex, England: Penguin.

Hutt, C. (1979). Cerebral asymmetry and hemispheric specialization--Some implications of sex differences. International Journal of Behavioral Development, 2, 73-86.

Hynd, G.W., & Scott, S.A. (1980). Propositional and appositional modes of thought and differential cerebral speech lateralization in Navajo Indian and Anglo children. Child Development, 51, 909-911.

Isaac, S., & Michael, W.B. (1974). Handbook in research and evaluation. San Diego: Knapp.

Janov, A. (1980). Prisoners of pain. New York: Anchor.

Janov, A., & Holden, E.M. (1975). Primal man. New York: Crowell.

Johnson, L.E. (1984). Vocal responses to left visual stimuli following forebrain commissurotomy. Neuropsychologia, 22, 153-166.

Johnson, P.R. (1977). Dichotically-stimulated ear differences in musicians and nonmusicians. Cortex, 13, 385-389.

Kallman, H.J., & Corballis, M.C. (1975). Ear asymmetry in reaction time to musical sounds. Perception & Psychophysics, 17, 368-370.

Kane, M. (1984). Cognitive styles of thinking and learning. Part One. Academic Therapy, 19, 527-536.

Karavatos, A., Kaprinis, G., & Tzavaras, A. (1984). Hemispheric specialization for language in the congenitally blind: The influence of the Braille system. Neuropsychologia, 22, 521-525.

Karson, S., & O'Dell, J.W. (1976). Clinical use of the 16PF. Champaign, IL: Institute for Personality and Ability Testing.

Kerlinger, F.N., & Pedhazur, E.J. (1973). Multiple regression in behavioral research. New York: Holt, Rinehart & Winston.

Kimura, D. (1961). Cerebral dominance and the perception of verbal stimuli. Canadian Journal of Psychology, 15, 166-171.

Kimura, D. (1964). Left-right differences in the perception of melodies. Quarterly Journal of Psychology, 16, 355-358.

Kimura, D. (1966). Dual functional asymmetry of the brain in visual perception. Neuropsychologia, 4, 275-285.

Kimura, D., & Archibald, Y. (1974). Motor functions of the left hemisphere. Brain, 97, 337-350.

Kinsbourne, M. (1970). The cerebral basis of lateral asymmetries in attention. Acta Psychologica, 33, 193-201.

Kinsbourne, M. (1972). Eye and head turning indicates cerebral lateralization. Science, 176, 539-541.

Kinsbourne, M. (1974a). Lateral interactions in the brain. In M. Kinsbourne, & W.L. Smith (Eds.), Hemispheric disconnection and cerebral function. Springfield, IL: Thomas.

Kinsbourne, M. (1974b). Mechanisms of hemispheric interaction in man. In M. Kinsbourne, & W.L. Smith (Eds.), Hemispheric disconnection and cerebral function. Springfield, IL: Thomas.

Kinsbourne, M. (Ed.). (1978). Asymmetrical function of the brain. Cambridge, England: Cambridge University.

Kinsbourne, M. (1981, May). Sad hemisphere, happy hemisphere. Psychology Today, p. 92.

Kirsner, K. (1980). Hemispheric-specific processes in letter matching. Journal of Experimental Psychology: Human Perception and Performance, 6, 167-179.

Klatzky, R.L. (1970). Interhemispheric transfer of test stimulus representations in memory scanning. Psychonomic Science, 21, 201-203.

Koff, E., Borod, J.C., & White, B. (1983). The left hemispace bias for visualizing emotional situations. Neuropsychologia, 21, 273-275.

Kolb, B., & Whishaw, I.Q. (1980). Fundamentals of human neuropsychology. San Francisco: Freeman.

Krug, S.E. (1978). Further evidence on 16 PF distortion scales. Journal of Personality Assessment, 42(5), 513-518.

Krug, S.E. (1980). Clinical Analysis Questionnaire manual. Champaign, IL: IPAT.

Krug, S.E. (1981). Interpreting 16pf profile patterns. Champaign, IL: IPAT.

Lake, D.A., & Bryden, N.P. (1976). Handedness and sex differences in hemispheric asymmetry. Brain and Language, 3, 266-282.

Lansdell, H. (1961). The effect of neurosurgery on a test of proverbs. American Psychologist, 16, 448.

Lassen, N.A., Ingvar, D.H., & Shinkhj, E. (1978). Brain function and blood flow. Scientific American, 239, 62-71.

LeDoux, J.E., Wilson, D.H., & Gazzaniga, M.S. (1977). Manipulo-spatial aspects of cerebral lateralization: Clues to the origin of lateralization. Neuropsychologia, 15, 743-750.

LeMay, M., & Culebras, A. (1972). Human brain--Morphological differences in the hemispheres demonstrable by carotid arteriography. New England Journal of Medicine, 287, 168-170.

LeMay, M., & Kido, D. (1978). Asymmetries of the cerebral hemispheres on computed tomograms. Journal of Computer Assisted Tomography, 2, 471-476.

Lenneberg, E. (1967). Biological foundations of language. New York: Wiley.

Levy, J. (1974). Psychobiological implications of bilateral asymmetry. In S. Dimond, & J.G. Beaumont (Eds.), Hemisphere function in the human brain. New York: Wiley.

Levy, J., & Gur, R.C. (1980). Individual differences in psychoneurological organization. In J. Herron (Ed.), Neuropsychology of left-handedness. New York: Academic.

Levy, J., & Nagylaki, T. (1972). A model for the genetics of handedness. Genetics, 72, 117-128.

Levy, J., & Reid, M. (1976). Variations in writing posture and cerebral organization. Science, 194, 337-339.

Levy, J., & Reid, M. (1978). Variations in cerebral organization as a function of handedness, hand posture in writing, and sex. Journal of Experimental Psychology: General, 107, 119-144.

Levy, J., & Trevarthen, C. (1976). Metacontrol of hemispheric function in human split-brain patients. Journal of Experimental Psychology: Human Perception and Performance, 2, 299-312.

Lewin, M. (1979). Understanding psychological research. New York: Wiley.

Lewis-Beck, M.S. (1980). Applied regression. Beverly Hills, CA: Sage.

Ley, R.G., & Bryden, M.P. (1979). Hemispheric differences in recognizing faces and emotions. Brain and Language, 7, 127-138.

Ley, R.G., & Bryden, M.P. (1982). A dissociation of right and left hemispheric effects for recognizing emotional tone and verbal content. Brain and Cognition, 1, 3-9.

Liberman, A.M. (1974). The specialization of the language hemisphere. In F.O. Schmitt, & F.G. Worden (Eds.), The neurosciences: Third study program. Cambridge, MA: MIT.

Lomas, J. (1980). Competition within the left hemisphere between speaking and unimanual tasks performed without visual guidance. Neuropsychologia, 18, 141-149.

Lomas, J., & Kimura, D. (1976). Intrahemispheric interaction between speaking and sequential manual activity. Neuropsychologia, 14, 23-33.

Longden, K., Ellis, C, & Iversen, D.S. (1976). Hemispheric differences in the perception of curvature. Neuropsychologia, 14, 195-202.

Loye, D. (1982, October). The brain and the future. The Futurist, pp. 15-19.

Luria, A.R. (1980). Higher cortical functions in man. New York: Basic Books.

Luria, A.R. (1973). The working brain. New York: Basic Books.

Maccoby, E., & Jacklin, C. (1974). The psychology of sex differences. Stanford: Stanford University

Marin, O.S.M., Schwartz, M.F., & Saffran, E.M. (1979). Origins and distribution of language. In M.S. Gazzaniga (Ed.), Handbook of behavioral neurobiology (Vol. 2). New York: Plenum.

Marshall, J.C. (1981). Hemispheric specialization: What, how and why. Behavioral and Brain Sciences, 4, 72-73.

McCallum, A.S., & Glynn, S.M. (1979). Hemispheric specialization and creative behavior. Journal of Creative Behavior, 13, 263-273.

McFie, J., Piercy, M.F., & Zangwill, O.L. (1950). Visual-spatial agnosia associated with lesions of the right cerebral hemisphere. Brain, 73, 167-190.

McGee, M. (1979). Human spatial abilities: psychometric studies and environmental, genetic, hormonal and neurological influences. Psychological Bulletin, 86, 889-918.

McGlone, J. (1977). Sex differences in the cerebral organization of verbal functions in patients with unilateral brain lesions. Brain, 100, 775-793.

McGlone, J. (1978). Sex differences in functional brain asymmetry. Cortex, 14, 122-128.

McGlone, J. (1980). Sex differences in human brain asymmetry. Behavioral and Brain Sciences, 3, 215-263.

McGlone, J., & Kertesz, A. (1973). Sex differences in cerebral processing of visuospatial tasks. Cortex, 9, 313-320.

Meskin, B., & Singer, J. (1974). Daydreaming, reflective thought, and laterality of eye movements. Journal of Personality and Social Psychology, 30, 64-71.

Milner, B. (1974). Hemispheric specialization: Scope and limits. In F.O. Schmitt, & F.G. Worden (Eds.), The neurosciences: Third study program. Cambridge, MA: MIT.

Milner, B., Branch, C., & Rasmussen, T. (1964). Observations on cerebral dominance. In A.V.S. De Reuck, & M. O'Connor (Eds.), Disorders of language. Boston: Little, Brown.

Mintzberg, H. (1976). Planning on the left side and managing on the right. Harvard Business Review, 54, 49-58.

Molfese, D.L. (1978a). Left and right hemisphere involvement in speech perception: Electrophysiological correlates. Perception and Psychophysics, 23, 237-243.

Molfese, D.L. (1978b). Neuroelectrical correlates of categorical speech perception in adults. Brain and Language, 5, 25-35.

Molfese, D.L. (1980). Hemispheric specialization for temporal information: Implications for the perception of voicing cues during speech perception. Brain and Language, 11, 285-299.

Moscovitch, M. (1973). Language and the cerebral hemispheres: Reaction time studies and their implications for models of cerebral dominance. In P. Pliner, L. Krames, & T. Alloway (Eds.). Communication and affect: Language and thought. New York: Academic.

Moscovitch, M. (1976). On the representation of language in the right hemisphere of right-handed people. Brain and Language, 3, 47-71.

Moscovitch, M. (1979). Information processing and the cerebral hemispheres. In M. Gazzaniga (Ed.), Handbook of behavioral neurobiology (Vol. 2). New York: Plenum.

Moscovitch, M., & Klein, D. (1980). Material specific perceptual interference for visual words and faces: Implications for models of capacity limitations, attention and laterality. Journal of Experimental Psychology: Human Perception and Performance, 6, 590-604.

Moscovitch, M., & Olds, J. (1982). Asymmetries in spontaneous facial expressions and their possible relation to hemispheric specialization. Neuropsychologia, 20, 71-81.

Moscovitch, M., Scullion, D., & Christie, D. (1976). Early versus late stages of processing and their relation to functional hemispheric asymmetries in face recognition. Journal of Experimental Psychology: Human Perception and Performance, 2, 401-416.

Natale, M., Gur, R.E., & Gur, R.C. (1983). Hemispheric asymmetries in processing emotional expressions. Neuropsychologia, 21, 555-565.

Nebes, R.D. (1974). Dominance of the minor hemisphere in commissurotomized man for the perception of part-whole relationships. In M. Kinsbourne & A. Smith (Eds.), Hemispheric disconnection and cerebral function. Springfield, IL.: Thomas.

Nettleton, N.C., & Bradshaw, J.L. (1983). Name and face matching in one or two visual fields: A test of models of hemispheric specialization. Brain and Cognition, 2, 103-118.

Newland, G.A. (1984). Left-handedness and field-independence. Neuropsychologia, 22, 617-619.

Newlin, D.B., Carpenter, B., & Golden, C.J. (1981). Hemispheric asymmetries in schizophrenia. Biological Psychiatry, 16, 561-582.

Nottebohm, F. (1979). Origins and mechanisms in the establishment of cerebral dominance. In M. Gazzaniga (Ed.), Handbook of behavioral neurobiology (Vol. 2). New York: Plenum.

Nottebohm, F. (1981). Does hemispheric specialization of function reflect the needs of an executive side? Behavioral and Brain Sciences, 4, 75.

Ojemann, G.A., & Whitaker, H.A. (1978). Language localization and variability. Brain and Language, 6, 239-260.

Olson, M.B. (1977). Right or left hemispheric information processing in gifted students. Gifted Child Quarterly, 21, 116-120.

Ornstein, R.W. (1972). The psychology of consciousness. New York: Viking.

Ornstein, R.W. (1976). The mind field. New York: Grossman.

Osborn, A.F. (1963). Applied imagination. New York: Scribners.

Otteson, J.P. (1980). Stylistic and personality correlates of lateral eye movements: A factor analytic study. Perceptual and Motor Skills, 50, 995-1010.

Parnes, S.J. (1977). CPSI: The general system. Journal of Creative Behavior, 11, 1-6.

Parrott, C.A. (1984). Personality characteristics associated with lateral eye-movement patterns. Perceptual and Motor Skills, 58, 867-874.

Paterson, A., & Zangwill, O.L. (1944). Disorders of visual space perception associated with lesions of the right cerebral hemisphere. Brain, 67, 331-358.

Patterson, K., & Bradshaw, J.L. (1975). Differential hemispheric mediation of nonverbal visual stimuli. Journal of Experimental Psychology: Human Perception and Performance, 1, 246-252.

Penfield, W., & Jasper, H.H. (1954). Epilepsy and the functional anatomy of the human brain. New York: Little, Brown.

Penfield, W., & Roberts, L. (1959). Speech and brain mechanisms. Princeton, NJ: Princeton University.

Peters, M. (1977). Simultaneous performance of two motor activities: The factor of timing. Neuropsychologia, 151, 461-466.

Peters, T.J., & Waterman Jr., R.T. (1982). In search of excellence: Lessons from America's best run companies. New York: Harper & Row.

Polich, J.M. (1982). Hemispheric differences for visual search: Serial vs parallel processing revisited. Neuropsychologia, 20, 297-307.

Popper, K.R., & Eccles, J.C. (1981). The self and its brain. New York: Springer.

Porac, C., & Coren, S. (1976). The dominant eye. Psychological Bulletin, 83, 880-897.

Power of beliefs, optimism tied to hemispheres. (1984, November 19). Brain Mind Bulletin, pp. 1-2.

Pratt, R.T.C., & Warrington, E.K. (1972). The assessment of cerebral dominance with unilateral E.C.T. British Journal of Psychiatry, 121, 327-328.

Rasmussen, T., & Milner, B. (1977). The role of early left-brain injury in determining lateralization of cerebral speech functions. Annals of the New York Academy of Sciences, 299, 355-369.

Ratcliff, G. (1979). Spatial thought, mental rotation, and the right cerebral hemisphere. Neuropsychologia, 17, 49-54.

Reynolds, R.C., Kaltsounis, B., & Torrance, E.P. (1979). A children's form of Your Style of Learning and Thinking: Preliminary norms and technical data. Gifted Child Quarterly, 23, 757-766.

Roberts, L. (1968). In P.J. Vinken, & G.W. Bruyn (Eds.), Handbook of clinical neurology (Vol. 4). Amsterdam, Netherlands: Elsevier.

Rogers, C. (1980). A way of being. Boston: Houghton Mifflin.

Rogers, L., TenHouten, W., Caplan, C.D., & Gardener, M. (1977). Hemispheric specialization of language: An EEG study of bilingual Hopi Indian children. International Journal of Neuroscience, 8, 1-6.

Ross, E.D., & Mesulam, M.M. (1979). Dominant language functions in the right hemisphere? Prosody and emotional gesturing. Archives of Neurology, 36, 144-148.

Ross-Kossak, P., & Turkewitz, G. (1984). Relationship between changes in hemispheric advantage during familiarization to faces and proficiency in facial recognition. Neuropsychologia, 22, 471-477.

Rossi, G.F., & Rosadini, G. (1967). Experimental analysis of cerebral dominance in man. In F.L. Darley (Ed.), Brain mechanisms underlying speech and language. New York: Grune & Stratton.

Rubens, A.B. (1976). Transcortical motor aphasia. In H. Whitaker, & H.A. Whitaker, (Eds.), Studies in neurolinguistics (Vol. I). New York: Academic.

Rudel, R., Denckla, M., & Spalten, E. (1974). The functional asymmetry of Braille letter learning in normal sighted children. Neurology, 27, 160-164.

Russo, M., & Vignolo, L.A. (1967). Visual figure-ground discrimination in patients with unilateral cerebral disease. Cortex, 3, 113-127.

Sackheim, H.A., Gur, R.C., & Saucy, M.C. (1978). Emotions are expressed more intensely on the left side of the face. Annals of the New York Academy of Sciences, 202, 424-435.

Sagan, C. (1977). The dragons of eden. New York: Random House.

St. James-Roberts, I. (1981). A reinterpretation of hemispherectomy data without functional plasticity of the brain: I. Intellectual function. Brain and Language, 13, 31-53.

Sanders, D.A., & Sanders, J.A. (1984). Teaching creativity through metaphor. New York: Longman.

Sandstrom, C. (1953). Sex differences in localization and orientation. Acta Psychologica, 9, 82-96.

Satz, P. (1980). Incidents of aphasia in left-handers: A test of some hypothetical models of cerebral speech organization. In J. Herron (Ed.), Neuropsychology of left-handedness. New York: Academic.

Schroeder, N., Eliot, J., Greenfield, S., & Soeken, K. (1976). Consistency of lateral eye shift related to preschoolers' performance on an analytical perceptual task. Perceptual and Motor Skills, 42, 634.

Schwartz, G.E., Davidson, R.J., & Maer, F. (1975). Right hemisphere lateralization for emotion in the human brain: Interactions with cognition. Science, 190, 286-288.

Schwartz, S.A., & Di Mattei, R. (1981). Mobius Psi-Q Test. Omni, 4(1), pp. 132-134; 136; 138; 159-160.

Schwartz, S., & Kirsner, K. (1984). Can group differences in hemispheric asymmetry be inferred from behavioral laterality indices? Brain and Cognition, 3, 57-70.

Scotti, G., & Spinnler, H. (1970). Color imperception in unilateral hemisphere-damaged patients. Journal of Neurology, Neurosurgery, & Psychiatry, 33, 22-28.

Seamon, J.G. (1974). Coding and retrieval processes and the hemispheres of the brain. In S. Dimond & J.G. Beaumont (Eds.), Hemispheric function in the human brain. New York: Wiley.

Seamon, J.G., & Gazzaniga, M.S. (1973). Coding strategies and cerebral laterality effects. Cognitive Psychology, 5, 249-256.

Searleman, A. (1977). A review of right hemisphere linguistic capabilities. Psychological Bulletin, 84, 503-528.

Segalowitz, S.J. (1983). Two sides of the brain. New Jersey: Prentice-Hall.

Segalowitz, S.J., Bebout, L.J., & Lederman, S.J. (1979). Lateralization for reading musical chords: disentangling symbolic, analytic and phonological aspects of reading. Brain and Language, 8, 315-323.

Segalowitz, S.J., & Chapman, J.S. (1980). Cerebral asymmetry for speech in neonates: A behavioral measure. Brain and Language, 9, 281-288.

Serafitinides, E.A. (1972). Laterality and voltage in the EEG of psychiatric patients. Diseases of the Nervous System, 33, 622.

Serafitinides, E.A. (1973). Voltage laterality in the EEG of psychiatric patients. Diseases of the Nervous System, 34, 190.

Sergent, J. (1982). The cerebral balance of power: Confrontation or cooperation? Journal of Experimental Psychology: Human Perception and Performance, 8, 253-272.

Sergent, J., & Bindra, D. (1981). Differential hemispheric processing of faces: Methodological considerations and reinterpretation. Psychological Bulletin, 89, 541-554.

Shapiro, D. (1965). Neurotic styles. New York: Basic Books.

Sheldon, W.H. (1942). The varieties of temperament. New York: Harper & Row.

Sherman, J. (1974). Field articulation, sex, spatial visualization dependency, practice, laterality of the brain and birth order. Perceptual and Motor Skills, 38, 1223-1235.

Sidtis, J. (1980). On the nature of the cortical function underlying right hemisphere auditory perception. Neuropsychologia, 18, 321-330.

Silverman, A., Adevai, G., & McGough, W. (1966). Some relationships between handedness and perception. Journal of Psychosomatic Research, 10, 151-158.

Smith, K.U., & Akelaitis, A.J. (1942). Studies on the corpus callosum: I. Laterality in behavior and bilateral motor organization in man before and after section of the corpus callosum. Archives of Neurology and Psychiatry, 47, 519-543.

Smokler, I.A., & Shevrin, I. (1979). Cerebral lateralization and personality style. Archives of General Psychiatry, 36, 949-954.

Sperry, R.W. (1964, January). The great cerebral commissure. Scientific American, pp. 42-52.

Sperry, R.W. (1968). Hemisphere disconnection and unity in conscious awareness. American Psychologist, 23, 723-733.

Sperry, R.W. (1974). Lateral specialization in the surgically separated hemispheres. In F.O. Schmitt, & F.G. Worden, (Eds.), The neurosciences: Third study program. Cambridge, MA: MIT.

Sperry, R.W. (1984). Consciousness, personal identity and the divided brain. Neuropsychologia, 22, 661-673.

Springer, S.P. (1977). Tachistoscopic and dichotic listening investigations of laterality in normal human subjects. In S.R. Harnad, R.W. Doty, L. Goldstein, J. Jaynes, & G. Krauthamer (Eds.), Lateralization and the nervous system. New York: Academic.

Springer, S.P., & Deutsch, G. (1981). Left brain, right brain. San Francisco: Freeman.

Stafford, R. (1961). Sex differences in spatial visualization as evidence of sex-linked inheritance. Perceptual and Motor Skills, 13, 428.

Strauss, E., & Moscovitch, M. (1981). Perception of facial expressions. Brain and Language, 13, 308-332.

Suberi, M., & McKeever, W.F., (1977). Differential right hemispheric memory storage of emotional and non-emotional faces. Neuropsychologia, 5, 757-768.

Sue, D.W. (1981). Counseling the culturally different. New York: Wiley.

Taggart, W., & Robey, D. (1981). Minds and managers: On the dual nature of human information processing and management. Academy of Management Review, 6, 187-195.

Teng, E.L., & Sperry, R.W. (1973). Interhemispheric interaction during simultaneous bilateral presentation of letters or digits in commissurotomized patients. Neuropsychologia, 11, 131-140.

Teuber, H.L., & Weinstein, S. (1956). Ability to discover hidden figures after cerebral lesions. Archives of Neurology & Psychology, 76, 369-379.

Thurstone, L. (1938). Primary mental abilities. Chicago: University of Chicago.

Torrance, E.P. (1982). Hemisphericity and creative functioning. Journal of Research and Development in Education, 15, 29-37.

Torrance, E.P., & Reynolds, R.C. (1980). Preliminary norms-technical manual for Your Style of Learning and Thinking, Form C. Athens, GA: Georgia Studies of Creative Behavior.

Torrance, E.P., Reynolds, R.C., Riegel, T., & Ball, O.E. (1977). Your Style of Learning and Thinking, Forms A & B: Preliminary norms, abbreviated technical notes, scoring keys, and selected references. Gifted Child Quarterly, 21, 563-573.

Trevarthen, C., & Sperry, R.W. (1973). Perceptual unity of the ambient visual field in human commissurotomy patients. Brain, 96, 547-570.

Tucker, D.M. (1981). Lateral brain function, emotion, and conceptualization. Psychological Bulletin, 89, 19-46.

Tucker, D.M., Watson, R.G., & Heilman, K.M. (1976). Affective discrimination and evocation in patients with right parietal disease. Neurology, 26, 354.

Tuckman, B.W. (1978). Conducting educational research. New York: Harcourt Brace Jovanovich.

Tzeng, O.J.L., Hung, D.L., Cotton, B., & Wang, W.S.Y. (1979). Visual lateralization effect in reading Chinese characters. Nature, 282, 499-501.

Urcuioli, P.J., Klein, R.M., & Day, J. (1981). Hemispheric differences in semantic processing: Category matching is not the same as category membership. Perception and Psychophysics, 29, 343-351.

Van Wagenen, W.P., & Herren, R.Y. (1940). Surgical division of commissural pathways in the corpus callosum. Relation to spread of an epileptic attack. Archives of Neurology and Psychiatry, 44, 740-759.

Vocate, D.R. (1984). Differential cerebral speech lateralization in Crow Indian and Anglo children. Neuropsychologia, 22, 487-494.

Wagner, M.T., & Hannon, R. (1981). Hemispheric asymmetries in faculty and student musicians and non-musicians during melody recognition tasks. Brain and Language, 13, 379-388.

Wallas, G. (1926). The art of thought. New York: Harcourt Brace.

Wechsler, A.F. (1973). The effect of organic brain disease on recall of emotionally charged versus neutral narrative text. Neurology, 23, 130-135.

Weiten, W., & Etaugh, C.F. (1973). Lateral eye movement as related to verbal and perceptual-motor skills and values. Perceptual and Motor Skills, 36, 423-428.

Wexler, B.E., & Heninger, G.R. (1980). Effects of concurrent administration of verbal and spatial visual tasks on a language-related dichotic listening measure of perceptual asymmetry. Neuropsychologia, 18, 379-382.

Wheatley, G.H. (1977). The right hemisphere's role in problem solving. Arithmetic Teacher, 25, 36-39.

Whitaker, H.A., & Ojemann, G.A. (1977). Lateralization of higher cortical functions: A critique. Annals of the New York Academic of Sciences, 299, 459-473.

Witelson, S. (1976). Sex and the single hemisphere: Right hemisphere specialization for spatial processing. Science, 193, 425-427.

Witelson, S. (1977). Early hemisphere specialization and interhemisphere plasticity: An empirical and theoretical review. In S. Segalowitz & F. Gruber (Eds.), Language development and neurological theory. New York: Academic.

Witkin, H. (1949). Sex differences in perception. Transactions of the New York Academy of Science, 12, 220-226.

Witkin, H.A., Goudenough, D.R., & Oltman, P.K. (1979). Psychological differentiation: Current status. Journal of Personality and Social Psychology, 37, 1127-1145.

Wittrock, M.C. (Ed.). (1980). The brain and psychology. New York: Academic.

Wolf-Dorlester, B. (1976). Creativity, adaptive regression, reflective eye movements, and the Holtzman movement responses. Dissertation Abstracts International, 36, 6458B-6459B. (University Microfilms No. 76-11,972)

Wolff, P.H. (1980). A difference that may make no difference. Behavioral and Brain Sciences, 3, 250-251.

Wolff, P.H., & Cohen, C. (1980). Dual task performance during bimanual coordination. Cortex, 16, 119-134.

Wonder, J., & Donovan, P. (1984). Whole-brain thinking. New York: Morrow.

Wood, C.C. (1975). Auditory and phonetic levels of processing in speech perception: Neurophysiological and information-processing analysis. Journal of Experimental Psychology: Human Perception and Performance, 1, 3-20.

Young, J.Z. (1962). Why do we have two brains? In V.B. Mountcastle (Ed.), Interhemispheric relations and cerebral dominance. Baltimore, MD: John Hopkins.

Zangwill, O.L. (1976). Thought and the brain. British Journal of Psychology, 67, 301-314.

Zurif, E.B., & Bryden, M.P. (1969). Familial handedness and left-right differences in auditory and visual perception. Neuropsychologia, 7, 179-187.

BIOGRAPHICAL SKETCH

Gary Lynn Harr was born on October 12, 1950, to Minnis Charles and Leota Virginia Harr. He is the first born of three children.

Mr. Harr graduated from Miami Palmetto High School in 1968 as a Florida Regent's Scholar. He received a Bachelor's degree in Psychology from Stanford University in 1972. Between 1973 and 1975, he attended the University of Florida as a Graduate Council Fellow and received Master of Education and Specialist in Education degrees in Counselor Education.

Since 1976, he has worked at Florida Junior College at Jacksonville as a student services professional; and as a microcomputer consultant in his own business, Phase 2 Technology. In August 1985, he completed the requirements for the Doctor of Philosophy degree in Counselor Education.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

E.L. Tolbert, Chairman
Professor of Counselor Education

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Robert Drummond, Cochairman
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